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AGRICULTURAL EXPERIMENT STATION
COLLEGE PARK, MARYLAND

Survey of Agricultural Research in Maryland

SEVENTY-NINTH ANNUAL REPORT

BULLETIN A-157

NOVEMBER, 1967



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1965-1966

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AGRICULTURAL EXPERIMENT STATION

BULLETIN A-157
COLLEGE PARK
MARYLAND
NOVEMBER 1967

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1965-1966

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AGRICULTURAL EXPERIMENT STATION
COLLEGE PARK, MD.

*To The Governor of Maryland
the Board of Regents,
and the President of the University of Maryland*

I transmit herewith the Seventy-Ninth Annual Report of the University of Maryland Agricultural Experiment Station, as established by Act of Congress, March 2, 1887, containing an account of research and experiments, conducted during the fiscal year ending June 30, 1966, and a statement of the receipts and disbursements for the same period.

I. C. Haunt
Director

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AGRICULTURAL ECONOMICS

A new survey was made of the 203 farms in the Central Piedmont area of Maryland that shipped milk in 1956, but only 120 farms were still shipping milk during the summer of 1966. Preliminary analyses of the survey data have been made.

Briefly, the typical Maryland dairy farm is still a two-man business, but it has 56 cows instead of the 36 cows which was the case in 1956. Average cows handled per man have increased from 19 to 26 cows during the past decade. The number of dairy farms shipping milk declined 41 percent, but total numbers of dairy cows on farms declined only 10 percent.

Man-years of labor declined sharply for this group of farms from 391 to 254 man-years. This 35 percent decline closely approximated the 41 percent decline in total dairy farms since 1956.

Maryland has continued to contribute to the regional research project by using linear programming analyses to determine potential dairy adjustments and milk supply responses. New representative farm situations were developed and analyzed using different production coefficients. Analyses were run on the 7094 computer for Area 20, and an aggregate supply function was developed.

Project A-18-au

Economics Aspects of Beef Cattle Production

In 1945, about 19 percent of the total cattle population in Maryland were non-dairy or beef animals. By 1965, this proportion had increased to about one-third. In view of the increasing importance of beef production in Maryland, this study was developed to provide physical input-output data on alternative beef systems on Maryland farms.

By applying prices to quantities sold and cost rates to inputs used, relative profitabilities of alternative systems were determined for several farm situations or available resource bundles.

Beef production, particularly the pro-

duction of some inputs than other enterprises. Also, some beef systems are more extensive enterprises than others.

Interviews with beef farmers during which data for this study were collected revealed a rather high proportion of operators working off the farm. However, off-farm employment by operators was more common among farmers producing and selling feeder cattle from cow-calf herds than among farmers producing and selling slaughter cattle.

The increased number of beef cattle relative to the number of dairy cattle in Maryland over the last two decades apparently is associated with the (1)



duction of finished slaughter animals from beef cow-calf herds, is a more extensive enterprise than many other possible farm enterprises in Maryland. Beef production is extensive in the use of labor, land, and capital as compared with poultry, dairy, and vegetable production.

Beef production can be combined more easily with off-farm employment than many other farm enterprises. The profitability of beef production is less sensitive to applications of greater quan-

increasing wage rates and greater difficulty of obtaining highly qualified, competent labor for more intensive operations, (2) increasing incidence of part-time farming, (3) more rapid increase in capital requirements for many other enterprises and perhaps, (4) the continued desire to use land and remain associated with farm production.

One example is provided in the accompanying picture. This barn, which formerly housed a herd of dairy cows, was converted to housing and feed stor-

age for a cow-calf herd. Earnings of the capital investment in the barn, complementary facilities, and 200 acres of land in this farm will likely be less than if they were continued in use as a dairy operation. However, the operator because he had gotten older, went into semi-retirement, and his only full-time hired man, previously employed on the farm, chose to leave farming as an occupation. Choices open to the owner-operator were (1) sell the farm and move to a new home, which he did not desire; (2) reduce the size of the dairy herd so that he could supply all required labor with some temporary hired labor during peak seasons, which he did not desire because this would not permit retirement and also would not likely be profitable, or (3) change the farm

organization from a dairy operation to some other farm enterprise. The latter was chosen, and the dairy herd was replaced by a herd of beef cows.

Linear programming analyses developed in this study indicated the ranges in slaughter price and feeder price ratios and resource combinations over which various beef systems were most profitable. Production of slaughter animals in a system from which purchased feeders usually was more profitable than other systems considered. These analyses, however, will enable those operators not following the most profitable system for their situation to determine income sacrifices they are making to pursue other objectives.

Project A-18-av

Return to Inputs on Cash Grain and Tobacco Farms

An experiment station miscellaneous publication entitled *Allotment Distribution and Major Inputs Used in Producing Maryland Tobacco* has been published.

Data on the size of all 1963 tobacco allotments were obtained from the Agricultural Stabilization and Conservation Service offices in Anne Arundel, Calvert, Charles, Prince Georges and St. Marys counties. Of the 6,615 allotments in 1963, 74 percent were less than 10 acres in size. However, the farmers with less than 10 acre allotments operated only 38 percent of the acres allotted.

From the ASCS records, a stratified random sample of 139 allotments was selected and the farmers interviewed for information on major inputs used in producing tobacco. To supplement

the above survey, a purposive sample of tobacco growers was selected to obtain detailed data on labor used in producing tobacco throughout a fourteen month period that extended from May 15, 1963 through July 15, 1964. Considerable effort was directed toward determining labor requirements for various tobacco operations.

On the average, it took 218 hours of labor to produce and market one acre of tobacco. This was a decrease of 47 hours per acre when compared to a similar study that was conducted in 1931. The major decrease in labor requirements occurred in those categories of production where new technology has been applied since 1931.

Productivity, as measured in pounds of tobacco per man hour, has increased substantially since the 1931 study.

Hours of labor required by major categories of production to produce one acre of tobacco in Southern Maryland in 1931 and 1963.

Item	Hours of man labor		Difference in hours of labor 1931-1963
	1931	1963	
Plant bed	22.0	7.5	- 14.5
Preparing field	20.8	6.0	- 14.8
Transplanting	23.8	23.9	+ 0.1
Growing	44.4	24.7	- 19.7
Harvest-house	49.9	45.3	- 4.6
Curing ^a	—	—	—
Post harvest field care	1.9	2.5	+ 0.6
Stripping and grading	102.7	102.1	- 0.6
Taking to market	.1	3.7	+ 3.6
Selling	—	.7	+ 0.7
Unclassified	—	2.3	+ 2.3
Total	265.6	218.7	- 46.9

^aGrowers included curing time in harvest-house category.

Project A-18-aw

Organization of the World's Agricultural Resources

People who work in human development commonly examine all possible factors affecting the development of a particular person. In this way, they gain insight into methods by which they can assist his development and also into the variety of ways in which the development of an individual can be influenced.

People who work in agricultural development should examine the great variety of possible factors affecting the development of a particular agricultural economy. In this way we can gain insight into ways by which we can assist the development of an agricultural economy and also into the variety of ways in which the development of an agricultural economy can be influenced.

The concept of a "system of agricultural resource organization," developed in this research project, by furnishing an analytical framework for studies of particular agricultural economies, pro-



A Ganda woman cultivating — women do most of the work in growing food crops.

vides the development economist with a useful approach to the problem of agriculture's contribution to economic development. As we increase the number of our studies in depth of par-

ticular agricultural economies, our competency to influence agricultural development should increase.

During the past year, studies of agricultural resource organization, using the analytical framework developed as a part of this research project, were completed for the following types of agriculture: The Kolkhoz of the U.S.S.R.; Feudal Village Irrigated Agriculture of Iran; and Buganda Rudimentary, Sedentary Agriculture in Uganda.

A broader discussion of the philosophy of this research project appeared in the May issue of the *Journal of Farm Economics* this past year. Here it was pointed out that the analytical framework developed for this project calls first for identification of the system of agricultural resource organization, second for a discussion of the institutional dimensions of the classical factors of production—land, labor, capital, and management—and third, for a discussion of the institutions used

by suppliers of purchased inputs and buyers of farm products.

Institutions affecting agricultural productivity vary widely throughout the world. Field patterns are an illustration. Fields tend to be large and rectangular in family commercial farming, small and circular in parts of tribal African shifting hoe cultivation, rectangular and greatly fragmented in the north-Indian Hindu village, and small and irregular in the Japanese village.

Management institutions show a similar variety. On the plantation, the choice of criteria used in decision-making may be chiefly profit maximization; on the socialized farm in Algeria, conforming to socialist doctrine becomes of primary importance; in the north-Indian Hindu village, tradition dictates most of the choices; and in some tribes which practice shifting hoe cultivation in Africa, the decision to move to an entirely new region may be brought about simply by the death of a wife.

Project A-18-ax

Profitability of Alternative Feed Handling Systems on Maryland Dairy Farms

Each dairy farm originally studied was revisited in March 1966 to ascertain changes in farm organization, dairy buildings and equipment and time and notion practices since the 1963-64 period. Each of the 12 farms has made some adjustments since the 1963-64 study. The general tendencies have been as follows: To increase cow numbers with the same labor force, to reduce crop acreages of small grains, pasture and hay, to increase the crop acreage of corn for grain and for silage, to incorporate new buildings and equip-

ment which save labor per cow and per 100 pounds of milk produced.

Research work in farm management at the University of Maryland has clearly established the close relationship which exists between changes in labor efficiency and changes in net farm income. There is a long-term trend in Maryland and the United States toward higher levels of labor efficiency as reflected by reduced man-hours per cow and reduced man-hours per hundred-weight of milk produced.

Mechanization of the farmstead

work routines, together with larger improved building layout, has been largely responsible for the decline in man-hours of labor used per dairy cow. This long-term decline in labor requirements per milk cow occurred in spite of the fact that milk production per cow has more than doubled in the past 50 years. The introduction of mechanical milking machines was an important factor in reducing labor requirements for the dairy enterprise.

Even more significant has been the reduction in labor per unit of output, which has dropped due to the increased production per cow and the lower labor requirements per cow. The average man-hours per hundredweight of milk produced in the United States have declined much more rapidly since 1940 than they did from the 1910-14 period until 1935-39. As a result of increased production per cow, this labor figure had dropped from 3.8 to 3.4 hours by 1935-39. No reduction occurred during this 25 year period in the labor requirements per cow which averaged nearly 150 hours per cow.

For 1966 a preliminary estimate has been made of one hour per 100 pounds of milk produced. This is a further decline from the level of 1.3 hours in 1960-1962 and 1.1 hours in 1963-1965. An average of 83 hours per dairy cow and an average of 8,080 pounds of milk produced per cow had been estimated for 1965 and 80 hours per cow and 8,300 pounds of milk per cow for 1966.

Increased production per cow has proven to be a major element in the improvement of labor efficiency on Maryland and United States dairy farms in recent years. Considerable reduction in labor requirements would have occurred due to this factor even if no reduction in man-hours per cow had taken place. If the past trend toward higher output of milk per cow continues, then this will have a built-in favorable influence toward higher dairy farm labor productivity in the future.

Reduced man-hours per cow have resulted from such factors as increased size of herd handled per farm and per man, increased use of milking machines and the increased use of automatic or mechanized methods of supplying water and feed, of cleaning the dairy barn and dairy equipment, and

Man hours per cow and per 100 pounds of milk and milk production per cow, Maryland and United States, 1910-1966 with potentials for the future.

Item	1910- 1914	1935- 1939	1945- 1949	1955- 1959	1960- 1962	1963- 1965	1966*	Potentials*	
								Present	Future
Man-hours per cow	146	148	129	109	96	87	80	30	20
Milk per cow (pounds)	3,842	4,401	4,992	6,307	7,195	7,848	8,300	15,000	20,000
Man-hours per cwt. of milk	3.8	3.4	2.6	1.7	1.3	1.1	0.96	0.2	.01

*Estimated by Dr. J. W. Wysong
 Source: "Labor Used to Produce Livestock", Economic Research Service, U.S.D.A., Statistical Bulletin No. 336, September 1963. A-18-ay Research Project on Maryland Dairy Farms.

of handling and storing the milk until it leaves the farm.

There is still considerable potential on most dairy farms to reduce labor per animal and per 100 pounds of milk produced. Increases in the average output of milk per cow are expected as dairymen continue to do a better job of managing, feeding and breeding their dairy herds in the future. Decreases in labor per cow will occur as farms with dairy cows expand in herd size and dairymen adopt more of the modern labor-saving methods for the care and feeding of their milking herds.

The labor used per 100 pounds of milk produced could be reduced in the near future from 1.0 to 0.5 of an hour by a number of combinations such as an increase in production to an average of 12,000 pounds per cow, and a reduction in labor to an average of 60 hours per cow. It is reasonable to expect high producing herds with 15,000 pounds of milk produced per cow and minimum annual labor requirements of 30 hours per cow to produce 100 pounds of milk with only 0.2 hours of labor.

Technology is currently available to make possible this extremely low labor requirement for milk production. Over a longer period in the future, dairymen will probably reduce annual labor requirements to 0.1 hours of labor per 100 pounds of milk.

Even on those farms that have made considerable progress in improving milking procedures and equipment installations, there is still much room for farmstead improvement. The reduction of

time and labor requirements with the dairy chore labor, especially milking time and feeding time, will continue to receive attention in the future as dairymen attempt to improve their labor productivity and efficiency. This study has provided general guidelines and principles to assist Maryland dairymen in analyzing their materials handling operations more adequately to improve labor productivity and efficiency.

The main problem on dairy farms is how the farm labor force should be balanced with the amount of work and number of jobs to be done. To gain maximum labor efficiency, the labor force must be closely fitted to the jobs at hand, and the workers must perform efficiently and effectively to accomplish the work. While many farmers have already made considerable progress in this direction, there is still much room for farmstead improvements, and increased operating efficiency.

The results of this study of concentrate, silage and hay feeding alternatives on Maryland dairy cattle farms will provide data to assist farmers in evaluating changes and adjustments in their feeding methods and facilities. Many dairymen must make new decisions with respect to adding more feeding facilities and remodeling old facilities as they expand the sizes of their dairy herds to improve their labor productivity and labor returns.

Project A-18-ay

Optimizing Returns to Resources on the Eastern Shore of Maryland

The share of total farm output in Maryland, originating on the Eastern Shore of Maryland, has been increasing over the last two decades. In many respects, trends on the Eastern Shore have been opposite from those found in other areas. Note the picture, which indicates new land being cleared and drainage ditches constructed to produce crops.

The proportion of the total value of agricultural products originating on Maryland farms on the Eastern Shore increased from 46 percent in 1959 to almost 52 percent in 1964. While land in farms in Maryland declined about eight percent between 1959 and 1964, land in farms on the Eastern Shore declined only six percent. Furthermore, land from which crops were harvested on the Eastern Shore did not change from 1959 to 1964, while harvested cropland declined about two percent for the state.

Crop sales represented about 45 percent of the total farm receipts on the Eastern Shore in 1964. For the state, crop sales represented about 34 percent of all farm receipts. Acreages devoted to corn and soybeans continue to increase. The mixed agricultural economy of the Eastern Shore is typified in the following picture. Production of broilers has been an important agricultural enterprise on the Eastern Shore since World War II.

This project was organized to generate a series of analyses to indicate the most profitable combination of crop and livestock enterprises for various farm situations and prospective future economic changes. One part of this study includes a determination of the



effects of land withdrawal programs on total agricultural output.

The total acreage of farmland diverted from agricultural production uses in Maryland varied from 14,600 acres in 1956 to more than 162,000 acres in 1961. Total acreage from which no crops were harvested in 1964 as a result of farmers participating in Federal Government land retirement programs was almost 108,000 acres. Land diversion programs in Maryland between 1956 and 1964 included from .5 to 4.7 percent of total land in farms and from 1.1 to 11.2 percent of total harvested cropland.

Cropland diversion programs, excluding the Conservation Reserve, which affected crop production very little, resulted in a reduction of total annual output of crops by not less than one percent and not more than eight percent. Effect of land diversion programs on the Eastern Shore was slightly greater than that for the state since the proportion of eligible acreage diverted was slightly larger and since crop production represents a greater share of the total output.

Project A-18-ba

Maryland Farm and Open Country Real Estate Transfers

This project deals with Maryland farm and open country real estate transfers. The specific objectives of this study are: (1) to discover the number of farm and open country real estate transfers in Maryland by county and election district, (2) to obtain information regarding the price of this land, (3) to discover the size of the tracts being transferred, (4) to obtain information on the types of transfer, and (5) to obtain information on the use of credit, type of lender and other pertinent information shown on the Property Transfer Record.

Since land is agriculture's primary resource base, and because it has been increasing in price very rapidly during recent years, it is desirable that we know more about the market for Maryland farms and open country real estate.

The collection of the Property Transfer Records for 1964, from each of the 23 counties, has been completed. The desired information from each of the transfer records has been coded, placed on code sheets and punched on IBM cards.

Three computer programs have been developed to process and analyze the data with respect to (1) consideration, (2) financing, and (3) assessment.

The consideration program examines, for each county and election district, the transfers for which there was a consideration. This program sorts the land transfers into 10 size categories and shows the number of transfers, total acres transferred, average size of transfer, total consideration and average price per transfer and per acre for each of the 10 size categories. This program

then summarizes the previously-mentioned information without regard to size categories.

The credit program examines, for each county and election district, transfers involving the use of credit. The program shows, with respect to eleven categories of lenders, the number of transfers, total acres transferred, total consideration, total amount of credit used and the credit as a percent of the total consideration. It also shows the percent of transfers, acres, consideration and credit furnished by each of the eleven categories of lenders. This program then summarizes the previously-mentioned information without regard to type of lender.

The assessment program examines, for each county and election district, all the transfers for which there was a recorded assessment. One part of the program shows, for five land use categories, the number of transfers, total acres transferred, total assessment, and assessment per acre with percentages of transfers, acres and assessment for each of the five categories. This program further shows, with respect to transfers with or without buildings and for all transfers, the total acres transferred, total assessment and assessment per acre.

This computer program also makes an assessment and consideration analysis for improved land, unimproved land and for all transfers. It shows the number of transfers, total acres transferred, total assessment, total consideration, average assessment per acre, average price per acre and assessment as a percent of consideration.

Number of Transfers, Acres Transferred, Total Assessment, Total Consideration, Average Assessment Per Acre, Average Price Per Acre, and Assessed Value as a Percent of Consideration, for Cecil County, Maryland, 1964*

Type of transfer	Number of transfers	Number of acres	Amount of assessment (dollars)	Total consideration (dollars)	Average assessment per acre (dollars)	Average price per acre (dollars)	Assessment as a percent of consideration
Improved	158	8,807	1,576,105	3,851,270	179	437	40
Unimproved	165	2,264	396,945	1,317,346	175	581	30
Total or average	323	11,071	1,973,050	5,168,616	178	467	38

Project A-18-bb

*Details may not add due to rounding.

The following data illustrate the type of information that is gotten from this project. In Cecil County the price of the land transferred varied from an average of \$304 per acre in election district 8 to an average of \$709 in election district 3, while the average price per acre for all land transferred in the county, which was included in this study in 1964, was \$467.

In Cecil County, in 1964, 132 transfers totalling 6,819 acres involved the use of \$2.24 million of credit. The credit amounted to 61 percent of the sale price

in election districts 1 and 2; 90 percent in election district 9 and was 71 percent for the entire county.

The assessment and consideration analysis for Cecil County for 1964 shows that on the average the transferred unimproved land was assessed at 30 percent of the sales price, improved properties were assessed at 40 percent of the sales price and that all the transferred properties were assessed at 38 percent of the sales price.

Project A-18-bb

Growth Patterns of Counties in Maryland since 1940

This study examined changes in employment by county and by industry for Maryland for the periods 1940 to 1950 and 1950 to 1960. In both periods, agricultural employment had the slowest growth rates of any industry in the state. In actual fact, agricultural employment declined during the 20-year period analyzed. However, it must be pointed out that since total marketings increased during the period, the decline in employment is more a re-

flection of improved production practices than of a declining industry.

The study showed that the metropolitan areas of Baltimore City, Baltimore County, Montgomery County, and Prince George's County were areas with high rates of growth in employment during 1940-50 and 1950-60. This is largely a reflection of the continued urbanization of the American society.

Project A-19-aa

Growth classification of industries in Maryland and comparison with the United States, 1940-50, 1950-60¹

Industries, 1940-50		Md. ²	Md. ³	U.S. ³	Classification ³	Industries, 1950-60		Md. ²	Md. ³	U.S. ³
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)		
1 Public Administration	+	+	+	high growth industries	1 Medical, Other Professional Serv.	+	+	+		
2 Armed Forces	+	+	+		2 Industry Not Reported	+	+	+		
3 Contract Construction	+	+	+		3 Public Administration	+	+	+		
4 Medical, Other Professional Services	+	+	+		4 Electrical and Other Machinery Mfg.	+	+	+		
5 Other Retail Trade	+	+	+		5 Armed Forces	+	+	+		
6 Wholesale Trade	+	+	+		6 Finance, Insurance, Real Estate	+	+	+		
7 Electrical and Other Machinery Mfg.	+	+	+		7 Printing and Publishing Mfg.	+	+	+		
8 Eating and Drinking Places	+	+	+		8 Other Transportation Equip. Mfg.	+	+	+		
9 Communications	+	+	+		9 Business and Repair Service	+	+	+		
10 Business and Repair Services	+	+	+		10 Trucking and Warehousing	—	+	+		
11 Motor Vehicles and Equipment Mfg.	+	+	+		11 Communications	—	—	—		
12 Other Transportation	+	+	+		12 Food and Kindred Products Mfg.	—	+	+		
13 Printing and Publishing Mfg.	+	+	+		13 Other Retail Trade	—	+	+		
14 Trucking and Warehousing	+	+	+		14 Entertainment, Recreation Service	—	—	—		
15 Finance, Insurance, Real Estate	+	+	+		15 Utilities and Sanitary Service	—	—	—		
16 Utilities and Sanitary Service	+	+	+		16 Mining	—	—	—		
17 Lumber, Wood Products, Furniture Mfg.	+	+	+		17 Motor Vehicles and Equipment Mfg.	—	—	—		
18 Entertainment, Recreation Service	—	—	—	slow growth industries	18 Forestry and Fisheries	—	—	—		
19 Forestry and Fisheries	—	—	—		19 Wholesale Trade	—	—	—		
20 Textile Mill Products Mfg.	—	—	—		20 Eating and Drinking Places	—	—	—		
21 Food and Dairy Products Stores	—	—	—		21 Textile Mill Products Mfg.	—	—	—		
22 Railroad, and Railway Express	—	—	—		22 Lumber, Wood Products, Furniture Mfg.	—	—	—		
23 Mining	—	—	—		23 Apparel Mfg.	—	—	—		
24 Food and Kindred Products Mfg.	—	+	+		24 Chemicals and Allied Products Mfg.	—	+	+		
25 Other Transportation Equipment Mfg.	—	+	+		25 Hotels and Other Personal Services	—	+	+		
26 Chemicals and Allied Products Mfg.	—	+	+		26 Other and Miscellaneous Mfg.	—	+	+		
27 Hotels and Other Personal Services	—	—	—		27 Food and Dairy Products Stores	—	—	—		
28 Other and Miscellaneous Mfg.	—	+	+		28 Other Transportation	—	—	—		
29 Industry Not Recorded	—	—	—		29 Railroads and Railway Express	—	—	—		
30 Apparel Mfg.	—	+	+		30 Private Households	—	+	+		
31 Private Households	—	—	—		31 Contract Construction	—	—	—		
32 Agriculture	—	—	—		32 Agriculture	—	—	—		
TOTALS	+17	+22	+22			+9	+15	+15		
	—15	—10	—10			—23	—17	—17		

¹ + = Industry mix exceeded the Maryland or U.S. average; — = Industry mix fell short of Maryland or U.S. average. ² Arrayed in decend-

Demand for and Availability of Land and Water Oriented Recreation Facilities in Maryland: Economic Analysis

The objective of this study is to determine facilities for land and water recreation in Maryland and to evaluate supply, demand and cost factors related to recreation. One phase of recreation selected for study was that of privately owned commercial campgrounds in Maryland. A list of campgrounds was compiled from Soil Conservation Service, State Department of Planning, and Rand McNally sources.

A statewide survey was planned to contact each of the listed campgrounds, and any others which could be located, to get information on size, facilities, services, fees and attendance. In addition,

a stratified sample of the campgrounds would be contacted further for fixed and operating costs.

The study of all marinas in Maryland with 10 or more slips was another phase of the recreation project. Again, a complete statewide survey of both salt and fresh water marinas was planned. The ownership and operator characteristics, and the facilities and services of marinas would be obtained. From the survey information, a sample stratified by size would be selected for obtaining detailed cost and revenue information.

Project A-19-ad



A tree-covered area (left) is preferred by campers to the open area (right). These open space areas were the last to be filled.

Maryland Farm Land Use Value Tax Under Scrutiny

There is speculation about who really benefits most from the Maryland farm land use value tax enacted 10 years ago. Moreover, efforts to modify the law have failed. Before major changes are attempted it would seem desirable to know more about the ownership of farm land subject to non-farm use pressures, as well as the factors that cause criticism of the law, and difficulty in administering the tax.

About 1900 farm tract sales, in seven counties near Baltimore and Washington, within the period of two and one-half years prior to July 1966, were studied. These sales amounted to about \$204 million and represented about 177,000 acres, or an average of \$1,150 per acre. Even in the more rural counties (Carroll and Frederick), urban residents purchased a large percent of the tracts and acreage; such purchases were 41 percent of the acreage in Carroll County and 52 percent in Frederick County.

Purchases of farm tracts were especially heavy during the last five years. Moreover, the resales of such tracts were quite frequent within recent years. About 31 percent of the tracts sold in Carroll and Frederick counties represented resales within five years, and 19 percent were resales within 10 years. Prices from such resales in four counties within five years were nearly doubled, and nearly tripled for those resales within 10 years.

An inventory of farm land ownership in five more urban counties in the fall of 1965 revealed that corporations owned about 18 percent of the acreage,

ranging from 12 to 35 percent among the counties. Nearly half of the acreage in these counties had been owned by the same parties for 10 or more years. Et al (group) ownership was rather high in some areas, representing as much as 19 percent in the more urban half of one county. This is much higher than normal et al ownership due to family holdings or estate settlement. From 26 to 47 percent of the acreage in the several counties had been acquired within the last five years.

Efforts to increase the tax assessment against farm tracts selling at abnormally high prices have varied among counties. Even in those counties where the most aggressive attitude is pursued, the success in reassessing farm land, seemingly headed for non-farm uses, at higher values has not been outstanding, when measured against the 50 to 60 percent standard of assessment to sale price.

Acreages in farms have been reduced by about 220,000 acres from 1954 to 1964 in the five more urban counties. However, there yet remains in these counties enough farm acreage, at three persons per acre, to provide for a population growth nearly twice the population of Baltimore City.

It appears, from the data analyzed so far in the study, that individuals or groups other than bona fide farmers are obtaining substantial property tax relief while waiting for real estate profits or planning for non-farm uses of the land. Moreover, these owners, as well as governmental agencies, create fantastic and variable land values by various methods, including spot zoning or

rezoning, isolated location of business and governmental facilities and subdivisions scattered throughout the rural areas.

This helps to stimulate farmland prices above reasonable limits, and

creates an imbalance between the supply of farm land and the non-farm needs even under the most optimistic population growth forecasts.

Project A-19-ac

Farm Policies on Maryland Agriculture

Maryland farmers participating in the acreage reserve of the Soil Bank received payments for diverting portions of their allotments of tobacco, corn and wheat into the program. Maryland farmers placed 14,600 acres of wheat, corn and tobacco allotments in the acreage reserve for 1956. Ten thousand, seven hundred acres of this land was diverted from corn, 3,400 acres from tobacco, and 500 acres from wheat. Thus, 73 percent of the land placed in the acreage reserve for 1956 was diverted from corn, 23 percent from tobacco and only four percent from wheat.

Total payments amounting to \$924,000 were given to Maryland farmers for their diversion into the acreage reserve, and over half of this sum was paid to tobacco growers for 23 percent of the acreage allotment diversion, 48 percent went to corn growers and less than two percent to growers who placed wheat allotments in the program. Thus, the payment per acre was much greater to tobacco growers than to either corn or wheat producers because tobacco is a labor intensive crop of high value per unit.

By 1958, the total number of acres diverted from corn, tobacco and wheat had increased to 64,000 and the payment to almost 5 million dollars. The

corn acreage diverted had increased almost four times, the tobacco diversion by about three times, and the acreage of wheat allotment diverted to the acreage reserve had increased more than ten fold. As a result, the wheat acreage placed in the acreage reserve increased to 18 percent of the total in 1958, while both corn and tobacco declined to 67 percent and 15 percent, respectively. Maryland corn growers who cooperated in the program received 43 percent of the total 5 million dollar payment made on the 1958 crop, tobacco growers received slightly less than 50 percent and wheat growers about six and one-half percent.

The tobacco diversion was particularly significant because it amounted to almost one-fourth of the entire tobacco allotment in 1958, and most of the diverted acres were never returned to tobacco production. Similarly, the acreage of land devoted to wheat production in Maryland continued to decline after 1958 to the extent that the diversion to the acreage reserve program from 1956-1958 inclusive was not returned to wheat production in the state. Only the acreage diverted from corn to the acreage reserve program was returned to production in Maryland after the end of the acreage reserve program.

The Feed Grain Program has been

effective since 1961. It is a voluntary program in which farmers are encouraged to divert acreage from feed grains to soil conserving uses in return for government payments. In 1961, the program included diversions from corn and grain sorghums only, in 1962 barley was added. Oats and rye were not included until 1964.

In 1961, Maryland farmers placed almost 80,000 acres of corn land in the program, and this acreage was not reached in any subsequent year.

In Maryland the yield per acre of feed grain, determined largely by year-to-year variation in weather conditions,

appears to have influenced total production more than the Feed Grain Program. Therefore, although acreage was generally lower after 1960, unusually favorable or unfavorable weather conditions at various times during this period tended to either off-set or emphasize the influence of diversions of feed grain acreage under the Feed Grain Program to the point that exact measurement of the impact of this program on production of the commodities affected is almost impossible to determine.

Project A-19-ae

Barriers to United States Direct Private Investment in Food Processing in Latin America

There are many barriers to investment by United States food processors in Latin America. These barriers are restricting the contribution United States food processing firms can make to the development and trade of this important geographic area.

The principal barriers to United States direct private foreign investment in Latin America fall in three categories: cost barriers, market barriers, and barriers related to some inadequacies or policies of the host government.

Cost Barriers—United States food processors in Latin America tend to pay somewhat higher taxes and wages than their local competitors. This is because they often are more conscientious in paying their full tax burden and because their workers are more frequently unionized.

Market Factors—Lack of a sizable market and competition for the existing

market appear to be the principal barriers to greater investment by United States food processor in Latin America. Most Latin American countries have relatively low purchasing power, and thus a limited capacity to absorb new investment. United States firms have entered these markets usually on a small scale, both to become established and grow with the markets, and to retain markets they had developed in the respective countries through exports from the United States. The latter step has become necessary due to the trend among Latin American countries to substitute domestic production for imports.

Government Inadequacies and Policies—United States investment in food processing in Latin America is greatly affected by the political climate. Investment usually drops sharply when the government takes an anti-foreign or anti-business attitude as illustrated by

the Goulart administration in Brazil and Peron's regime in Argentina. Investment is often stifled by threats of/ or actual expropriation, price controls, inflation, exchange control, currency devaluation, left-wing agitation, and terrorism.

Most Latin American governments want United States foreign investment and have specific laws encouraging it. The government related barriers to investment faced by United States firms are generally not intended by the governments but occur in spite of what they are able to do.

The United States government has several programs designed to stimulate further foreign investment by United States firms. These include providing insurance against political and business risk, financing investment surveys, and providing loans.

Several measures have been suggested for increasing United States investment in Latin America. These include having the United States government increase the availability of local and U. S. currency loans, reducing taxes on foreign income to provide a minimum rate of return to investors, reducing the cost and increasing the coverage of the investment insurance program, and financing U. S. management teams.

Other suggestions for stimulating U. S. foreign investment in Latin America include increased regional integration (a more extensive common market), improving the image of private enterprise in Latin America, and improving the image of Latin America in the eyes of U. S. investors.

Project A-26-bn

Current Structure of Livestock and Meat Marketing

The primary emphasis of this study is to analyze the competitive position of Maryland broiler-processors.

A computer simulation model is being developed using model firms for Maryland and its major competing areas (Maine, Georgia, etc.). Using

this simulation model will enable researchers to better estimate the economic impact on Maryland broiler-processors of changes in freight rates, feed grain programs, and other factors vital to the economic survival of these firms.

Project A-26-bo

Current Structure of Livestock and Meat Marketing

The changes occurring within the livestock segment of the agricultural community strongly suggests that new base points for formulating alternatives for marketing livestock efficiently must be identified. The profitability of the operation of the livestock marketing firm as well as the livestock producer are at stake.

Supporting data to estimate the shape and structure of the livestock market structure have been collected. Differences among and between types of markets concerning their operations have been tested statistically.

Generally, all livestock markets in Maryland have in the recent past and currently are facing declining receipts of

salable stock. In the aggregate, however, the terminal market receives about an equal number of cattle, one-third more hogs, one-third more of the sheep and lambs, and about ten percent of

the calves marketed. It remains as a significant market outlet for livestock produced in Maryland.

Project A-26-bp

Economic Analysis of Alternative Marketing Systems for Eggs in Maryland

This study is concerned with evaluating alternative egg marketing systems in Maryland and the extent to which they (1) meet the requirements of various markets and (2) affect the competitive position of Maryland egg marketing firms.

To date, 25 egg marketing firms have been interviewed. A publication by R. W. Schermerhorn and C. E. Reid entitled "The Market Structure and Organization of the Maryland Table Egg Industry" presents an analysis of the data obtained from these interviews. Results of the study indicate that:

(1) plants are becoming larger in scale of operation; (2) the major determinations of plant location are wage rates and capital investment costs in the area, and cost of transportation; and (3) further development of the Maryland egg packing industry may reveal a vertically integrated industry.

This study also revealed the integral part that pricing plays in the marketing of eggs. Consequently, attention is now being directed toward an analysis of alternative pricing systems for Maryland eggs.

Project A-26-bq

Institutional Factors Affect Fluid Milk Marketing Systems

Post World War II changes in the institutional environment of the Washington, D. C. fluid milk market from 1945 to 1965 were major factors affecting the decisions of milk trade organizations, (producer cooperatives, commercial handlers, and retail food stores), to alter their marketing systems and practices.

In 1947, Federal Order 45 was terminated by producers because its Class I price formula was causing price adjustments considered contrary to their interests. This institutional change initiated a chain of adjustments in the market.

First, the prewar practice of price bargaining between individual dealers and producers, cooperative or independent, was re-established. This change from administered prices under federal law to collective and individual bargaining in turn precipitated an anti-trust suit involving the major cooperative and its dealer patrons. The decision of the district court conformed to prevailing interpretations of the Clayton Act exempting cooperatives from the major monopoly and conspiracy provisions in anti-trust legislation, thus leaving the anti-trust aspects of the institutional environment unchanged.

Soon after the war, several modifications were made in the interpretation of District of Columbia health regulations pertaining to fluid milk. First, the emergency war time authorization to distribute milk produced on farms other than those holding permits from the District of Columbia Health Department was withdrawn, but milk from such farms could still be processed in D. C. plants for distribution outside the District of Columbia.

Subsequently, the use of chemicals in lieu of steam boilers for sanitizing milk-handling equipment on dairy farms was adopted.

These changes in the public health institution contributed to a rapid and revolutionary adjustment in the milk procurement system of the market from the use of surface coolers, and country receiving stations to refrigerated bulk tanks on farms and tank truck hauling directly to processing and distribution plants.

Finally, two additional modifications contributed to a new institutional environment by 1965, which was associated with a significantly different pattern of marketing systems and practices.

In attempting to maximize its power as bargaining agent for its membership, the major cooperative in the market purchased all the assets of an established

processing and distribution firm in the market.

This action culminated in an anti-trust case, which was finally decided by the Supreme Court of the United States to the effect that prior lower court decisions concerning statutory anti-trust immunity for agricultural cooperatives was in error. Hence, the 1965 institutional environment of the Washington, D. C. milk market was much less liberal concerning the legally permissive competitive practices of agricultural cooperatives than it had been 10 years before.

During the decade after the termination of Federal 45 in 1945, the participants and supporters of producer cooperation found that handlers were jeopardizing the entire system of classified pricing and collective bargaining by "riding" the cooperative's blend price, while limiting purchases from "independent" producers to their fluid needs.

This device forced the "burden of surplus" upon cooperative producers, and provided dealers with a potent competitive weapon for soliciting milk from "independent" producers at a flat price regardless of use. As a result, a new federal order became effective and a uniform minimum class price system was re-established under federal law.

Project A-26-br

An Economic Analysis of the Role of Farmer Cooperatives as Marketing Organizations

Farmer owned cooperative associations play an important role in the marketing of several major agricultural products of Maryland. The trend towards larger but fewer, more productive

farms has placed increased demands for services on the cooperatives. To insure maximum returns to producers, marketing cooperatives are moving from exclusively bargaining associations to

processing, wholesaling, retailing and purchasing supplies.

Of the five marketing cooperatives studied, all are vertically or horizontally integrated to some degree. The total value of raw farm products marketed for members was slightly less than \$90 million. In addition to direct marketing, related services included trucking, inspection and laboratory testing, field services, grain storage, purchasing of dairy equipment, automotive equipment, machinery, and farm supplies.

Major objectives for future development of the cooperatives as expressed by management and the boards of directors, in summary were: (1) Increased prices for products sold; (2) Reduced prices of supplies purchased; (3) Expansion and integration of facilities and services to accomplish the first two objectives.

There appears to be strong feelings that the cooperatives must carry the farm products to the consumer. Expansion of purchasing activities by some marketing cooperatives is felt to be needed in reducing production costs. While the short run effect of specialized purchasing activities appears as a savings to members, the long run total cost of this phase is questionable.

The long run goals of Maryland marketing cooperatives remains unchanged. In recent years the objectives of expansion and integration are supplementing the pure price bargaining function of the marketing cooperatives. Cooperative executives and board members agree that they must be alert to all new marketing developments and keep up with, or ahead of, their non-cooperative competitors.

Project A-26-bs

Marketing Channels of Floricultural Products, Ornamentals

The objectives of this study were to identify the marketing channels used by Maryland producers of floricultural and ornamental products and to determine sources of supply (other than Maryland) of floricultural and ornamental products moving through the Maryland marketing channels and at what point(s) entry is made into these channels.

Results obtained from mailed questionnaires indicated that most of the floricultural and ornamental products produced in Maryland are marketed in Maryland and Washington, D. C. However, there are substantial marketings in the states that border on Maryland.

This study is the first in a planned series that will examine the problems

and potentials of Maryland's floricultural industry.

Project A-26-bt



A University of Maryland research assistant interviews Maryland flower producers in study of marketing channels of floriculture products.

Evaluation of Market Structure Performance in Marketing Northeast Fruits and Vegetables

In order to evaluate market structure performance of Maryland produced vegetables for fresh market, tomatoes, sweet corn and green beans were selected for this study, which covers from the grower to the retail level of market performance. The investigation will have the following areas of emphasis for the commodities under study:

1. Description of current market structure.
2. Identification and quantification of major impediments to orderly and efficient marketing.
3. Gathering suggestions for improvements in the current market structure.

When the information from all levels has been gathered, alternative market structure arrangements will be developed. From this portion of the inves-

tigation, an "optimum" market model will be constructed for Maryland produced tomatoes, sweet corn and green beans for fresh market.

Work during the current period has taken two major directions. The first was in terms of making over all plans for the duration of the four-year project.

The second direction was in terms of conducting a survey of selected Maryland growers of tomatoes, sweet corn and green beans for fresh market. The results of this portion of the study will be used to develop the farm level portion of the "optimum" market model.

*Project A-26-bu
(NEM-34)*

Fisheries and Seafood Processing

The 1964 catch in the Chesapeake Bay Fisheries, one of the nine major fisheries in the United States, was valued at 36 million dollars. There were 18,620 fishermen employed in the Chesapeake Bay Fisheries in 1964.

The output of packaged, canned, cured, and industrial fishery products in the Chesapeake Bay Area (Maryland and Virginia) was valued at over 65 million dollars in 1964. An average of 10,284 people were employed during the 1964 season in 622 Chesapeake Bay Area seafood wholesaling and manufacturing establishments.

The objectives of this study are: (1) to analyze the demand for seafood by



region in the United States; (2) to analyze the supply of seafood from the Chesapeake Bay Fisheries; (3) to determine the economic factors affecting the size and location of the seafood processing industries in the Chesapeake Bay Area.

The project will provide useful infor-

mation about the historical development and the economic factors operative in these industries. It will also provide a basis for projecting several economic variables which are important to both government and private decision makers.

Project A-26-bv

Feasibility of New or Re-organized Agricultural Marketing Facilities

A study of poultry plants of varying sizes, showed that certain economies of scale will lead to a downward trend in number of plants in the event that aggregate output of further-processed products begins to decelerate. At the time of the study, the number of plants engaged in further-processing was still expanding. Four model plant sizes were developed for the study with six dissimilar kinds of products in each.

Single-product plants were able to produce products at lower average costs per unit than multiple-product plants of comparable volume of output. Higher unit costs in multiple product plants was due to increased complexity of the operation and inability to have joint use of equipment and facilities.

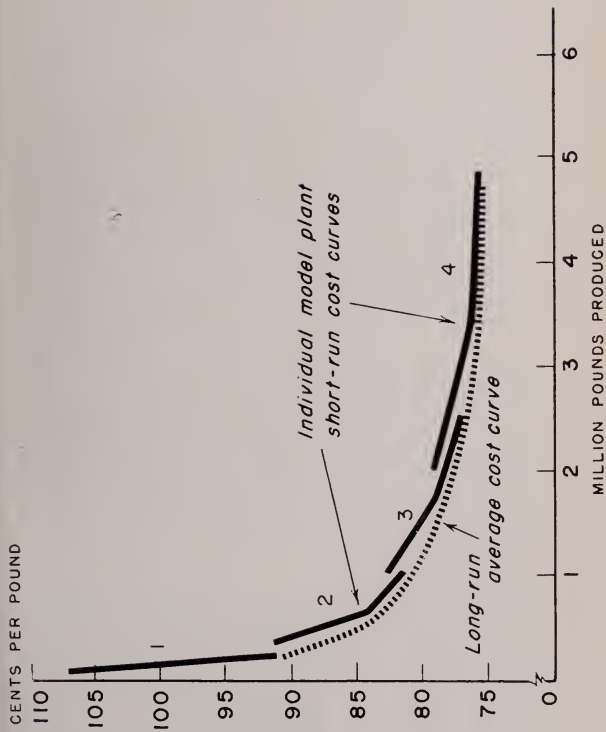
It was shown that, if additional units of further-processing were added to already existing slaughtering and eviscerating functions, the number of plants in the industry would decline. However, the addition of new product lines to existing plants would lead to increased usage of poultry meat.

Production of further-processed food items requires substantial investment in plant and equipment for preparing consumer and institutional sized units. As plant size increases a high degree of



automation is required and new technology and skills are required of management. In the poultry field, eight percent of the plants used 70 percent of the meat used for further-processing in 1964. More than three-fourths of the plants engaged in further-processing were disassociated with slaughtering and eviscerating operations.

Project A-26-bw



2. Long-run and short-run average cost curves for four model plants producing turkey rolls.

Causes and Consequences of Major Changes in the Structure of Agricultural Markets

Most of the major changes in the structure of specific markets was found to have resulted from changes in marketing technology and changes in market structure at other levels in the marketing system coupled with marketing firms' drive for maximum profits.

As marketing technology and outside market structures change, firms within respective markets frequently find that their profits are maximized by new methods of doing business. These new, generally low cost, methods often change the market's structure itself which in turn has consequences for market competition and efficiency.

The importance of innovations and firm profit maximization in changing market structure, and in turn, generally improving the marketing system have

been generally overlooked by economists because economists traditionally have concentrated on how firms price their products and allocate resources in a static market situation. They have generally ignored how long run improvements in the marketing system occur, an area considerably more important than the former.

It appears that among other methods, innovations in marketing technology could be stimulated by allowing faster tax write-off on new investments. It also appears that many improvements in market structure could be brought about by loosening up on the many minimum freight rates imposed on public carriers.

Project A-26-bx

Economic Analysis of Forest Marketing Structure

Economic analysis of forest marketing firms in Maryland revealed there were 188 sawmill operators licensed (1964) to do business. In 1966, a survey was made of 114 firms that showed an average investment of \$93,000 per firm and average volume of sales of \$145,000. Two-thirds of the mills produced more than 200,000 board feet of lumber per year and 20 percent of those interviewed sawed more than 750,000 board feet. The purpose of the study was to determine present practices in marketing forest products and develop improved market structure from an industry standpoint.

Another phase of the study involved a survey of 60 forest producers, i.e.,

persons who cut and truck timber products in Maryland. This enterprise is characterized by frequent entry and exit firms, comparatively low investment, small work crews and a high rate labor turnover. Producers required a good credit rating to buy timber and



pay farmers in advance of receipts. Volume of sales per firm amounted to \$40,000 per year.

Landowners who sold timber in the past year were surveyed. Imperfect knowledge of timber sales was quite evident as a result of these interviews. Owners had little knowledge of timber evaluation. Sales contracts were loosely worded and included allowances for land clearing, road building, building of trails, removal of slash and repair fences.

Sales of timber by land owners is frequently treated as surplus, meaning anything received from the sale is a net gain and better than nothing. Not much effort was exerted by the landowner to determine true value before the sale was finished. Sales of timber were high when there was a field crop failure or other reasons for needing extra cash. More than one-half of the contracts were oral agreements.

Project A-26-by

AGRICULTURAL ENGINEERING

Applications of engineering enhance the economical production, harvesting, transportation and marketing of agricultural commodities. The nature of such enhancement is twofold; first, cost of production, etc., is minimized and, second, onerous chores are reduced or eliminated. Applications of engineering also play an important role in the utilization and conservation of natural resources so important to sustained production and the quality of our environment.

In the Agricultural Engineering research program, engineering faculty members, in cooperation with faculty members of the agricultural sciences, direct their efforts towards improved equipment or techniques to enhance overall production efficiency.

Current projects have specific objectives such as determination of the optimum environment for broilers, development of a machine to successfully harvest sweet potatoes, development of a machine and techniques for control of the alfalfa weevil with heat, development of machinery, techniques and facilities for a system of mechanized harvesting and curing of tobacco, and the utilization of wastes from livestock operations or processing plants for crop production through hydroponics or return to the land.

Instrumentation for sensing, measuring, controlling and recording temperatures, forces, direction of forces, moisture and rates of changes of these are critical to engineering studies for determination of environmental quality or for criteria essential to design of a successful machine. During the past several years, new instruments have been added, including automatic data acquisition units from which data recorded on punched tape or magnetic tapes can be processed directly by computers. It is fortunate that by rearrangement of sensors, amplifiers, etc., such instruments can be utilized on different projects.

The research capability of the Department faculty is broadened by two Cooperative Agents; employees of the Agricultural Engineering Research Division, Agricultural Research Service; and the U.S. Department of Agriculture.

Effect of Rate Displacement on Shear Strength of Soil as Measured with a Torsional Shearing Device

A torsional shearing device called a Desometer was used to study the effect of rate of displacement on soil shear strength. Tests were conducted with Decatur silty loam, Lloyd clay, Vaiden silty clay and Congaree silty loam soils at the National Tillage Machinery Laboratory, Auburn, Alabama.

Data indicated that shearing stress

was a function of rate of displacement in some cases, not in others and questionable in others. Tests indicating a rate affect had percent saturation of 35 or greater and moisture contents approximately equal to the lower plastic limit.

Project R-26

Farmstead Water Requirements and Farmstead Water System Design

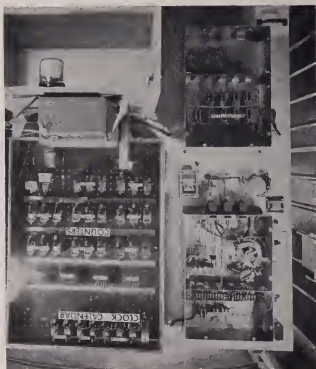
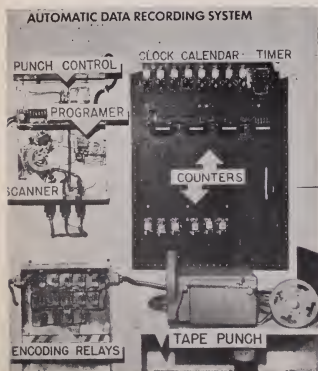
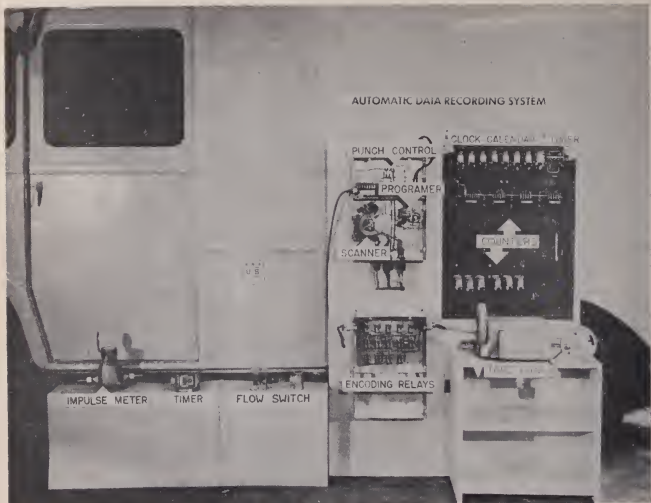
Farmstead water use was recorded on three farms. One farm had a large intermediate storage system installed in 1964. On the other two, a portable intermediate storage system was used to eliminate limitations of source. Because of the drought, peak one-day water use at Manor Dairy exceeded daily source yield. However, peak one-day demands occurred on alternate days so that replenishment of storage between peak days was possible.

This operation further confirms the desirability of intermediate storage, but operation so near total available supply should not be encouraged. Where no back up source is available, designing the source of supply for a system for only on 12 hours pumping time should be the recommended minimum.

At the Stanley Stiles farm, the source of water supplied daily requirements in 10 hours and the peak demand exceeded well source capacity for two hours. Peak demand did not approach calculated demand as friction loss limited demand and stock watering facilities were limited.

All data collected tend to substantiate the values published in ASAE Paper 64-232 Dairy Farmstead Water Use. Adequate household water requirements data were collected and analyzed jointly with Johns Hopkins University, Sanitary Engineering Department, to permit making strong recommendations for use of Hunter's demand curve to determine peak household demand.

Cooperative Project with USDA



Automatic water use measuring and recording system used to determine total use and peak rates at several locations in farmstead water supply research.

Farm Animal Waste Management

Work on farmstead wastes disposal during the past year concentrated on an analysis of the effectiveness of various forage grasses in removing plant nutrients from waste disposal lagoon effluents.

Results showed an average, by species, of 65.5 percent reduction of P_2O_5 by rye grass for a five day detention time and 79.8 percent reduction in nitrates for a five day detention time for tall fescue.

The plastic greenhouse mentioned in last year's report functioned well all winter, but due to stoppages in the effluent supply line, no reportable data were obtained.

Additional projects under way at the present are a 7 x 60 ft. polyethylene lined gravel bed 15" deep, which is taking effluent from the lagoon at a rate of 1,000 gal./day. This will be adjusted as evaporation and transpiration rates change so that the discharge will be 1,000 gal./day. This is a calculated value based upon greenhouse studies.

The effluent line will be buried to

prevent freezing as well as damage from tractors. Studies on nutrient removal will be carried out until such time as the bed freezes solid — if it does.

A primary and secondary septic tank and double drain field has been installed at the University of Maryland Swine Research Farm to test the feasibility of using this method of swine waste disposal.

To date, management and design problems have held up the full time use of this unit so that no reportable data are available on this project.

Work for this year will be concentrated upon the relationship of one plant nutrient to the other two. It is anticipated that a deficiency probably exists in the potassium supply and with the recent availability of a flame spectrophotometer the difficulties in analysis should be overcome.

Performance of the hydroponic bed will continue to be studied. Septic tank drain field system hopefully will be operational.

Cooperative Project with USDA

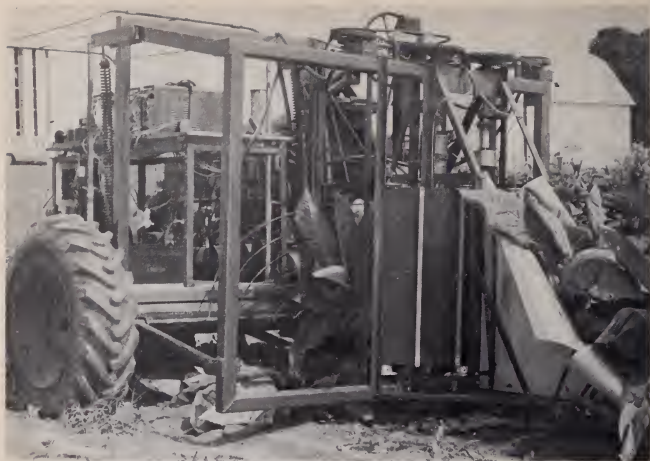
Mechanization of the Tobacco Harvester

The objective of this project is to develop a complete system of harvesting and handling Maryland tobacco using compact curing. The harvester is being developed in stages. A Minneapolis-Moline Unitractor was used to propel the unit.

The first stage was the development of the cutter mechanism of the harvester. This was achieved by overlap-

ping 16-inch diameter plow coulter blades mounted on vertical shafts and driven by hydraulic motors. The left blade was smooth and the right notched. Because the forces required to cut the plants were unknown, it was necessary to measure them to have adequate design criteria for further use.

Torque and two components of radial force were measured on each coulter



Tobacco cutter mounted on a Minneapolis-Moline Unitractor.

blade. Strain gages were used to sense the torques and the forces on the coultter blades when operating. Light beam galvanometers and a photo-sensitive chart were used to record the measured values of torque and forces for each individual plant. The physical size of each plant was measured and recorded. Three ground speeds (1, 1½, 2 mph) were tested in a randomized block design.

The data were analyzed on a digital computer. To determine the relationship between stalk dimension and cutting forces, a regression analysis was made. Comparison of the slopes of the regression lines of the relationships between a torque, or component of force and the stalk outside diameter and ground speed indicated the data could not be reasonably described by a single regression line.

The mechanism for cutting the tobacco stalks in the field performed satisfactorily. The torque exerted on the notched coultter blade increased as the outside stalk diameter increased, while the torque on the smooth coultter blade decreased as the ground and coultter speed increased. The average force perpendicular to the direction of travel is independent of the ground speed. The total force parallel to the direction of travel increases as the forward speed increases. Both the average force perpendicular to the direction of travel and the total force parallel to the direction of travel increased as the stalk diameter increased.

The first cutting mechanism utilized power for both coultters. Analysis of the forces, as measured on the first model, indicated the possibility of successful operation with powered opera-

tion of the notched coulter and with the smooth coulter idling. In the second model, only the notched coulter was power driven and even with the simplified mechanism satisfactory operation was obtained.

The second stage of harvester development, the design and testing of a

packaging unit is in progress. Essentially the first packaging unit is a modified baling mechanism which was operated enough in 1966 to identify operational problems. Design of this unit will be refined and a second model will be field tested in 1967.

Project R-11-h

Tobacco Housing

The speared tobacco cured during the 1965 season in the compact curing facility was sold on the auction market for an average of \$77.23 per 100 pounds. The net average auction sales for the entire 1965 crop was \$65.27. This tobacco was of excellent quality which could be at least partially attributed, to the control of temperature and humidity within the curing facility during curing.

The non-speared tobacco supported on a wire floor only produced moderate success. Changes in handling by tying the tobacco into bundles of six to 12 plants during the 1966 season produced a more satisfactory cure.

Because of the outstanding success of curing 19 speared plants to a four foot stick that were hung eight inches apart, a study of handling techniques from cutting through curing was undertaken.

Each stick weighed approximately 60 pounds; therefore, a system of loading these onto a trailer-mounted frame in the field was used. Each frame held approximately 760 plants of tobacco.

The frames were mechanically removed from the wagon. The loaded frames were then placed in a pole frame structure for curing. Plastic was used to cover the sides and top of the structure. Air was forced through the tobacco during the day at the rate of 3.5 cfm per plant. Supplemental heat was provided. One half acre (3,000 plants) was cured in the structure, and excellent results were obtained. Manhours required to harvest by that method, as compared to conventional methods, decreased from 56 to 34 manhours per acre, a reduction of 39.4 percent.

Project RB-11-g



Fresh-cut tobacco speared 19 plants on 4-foot stick ready for hanging.



Trailer with frame for hanging tobacco ready to be filled.



Trail with frames filled ready to be taken to curing facility.



Curing facility covered with plastic. Fan and heater in place.

Environmental Requirements of Poultry

Three trials were conducted in the controlled environment pens. The trials were designed to study the effect of rates of temperature reduction during brooding, high and low humidity, and abrupt temperature and humidity changes during the growth period.

One hundred White Rock Cockerels,

which were not vaccinated against any disease and said to be free from PPLO, were started in each pen. The feed used was a pelletized commercial broiler ration containing a coccidiostat. Each trial will be discussed individually.

Trial 1

In trial 1, all four pens were started at 90°F., with a constant relative humidity of either 40 percent or 85 percent. One pen at each humidity was reduced in temperature 1°F each day while the others were reduced 1.5°F each day. When the temperature got down to 65°F, conditions were held constant for the remainder of the trial.

An analysis of the results indicate little differences between treatments. The poorest growth rate occurred in the 40 percent RH Pen reduced 1.5° per week (Pen 4). The chicks raised at the lower humidities consumed more water and feed than did the birds at higher humidities.

Trial 2

In trial 2, the starting temperature for all pens was 90°F. The variable for this trial was the rate of reduction in brooding temperature. Two pens were reduced 1°F each day, while the other two were reduced 2°F each day. When 65°F was reached, the temperature was held constant at this level for the remainder of the trial. However,

the relative humidity was held at a constant level of 60 percent in all pens for this trial.

From observation of the data in the table it can be seen that when the replications were averaged no significant differences resulted from the variables used.

Trial 3

For trial 3, all pens were started at 90°F and the temperature was reduced 2°F each day until it got down to 70°F. The relative humidity was held at a constant level of 60 percent in all pens during the first through the third

week. When the chicks were three weeks old, the temperature was abruptly raised to 90°F in four pens and held at this level for two weeks.

The humidity in pens 1 and 4 was raised to a high level i.e., about 90 per-

Summary of Results of Trial—1

Pen Number	1	2	3	4
Starting temperatures	90°	90°	90°	90°
Constant relative humidity	85%	40%	85%	40%
Rate of temperature reduction	1°/day	1°/day	1½°/day	1½°/day
Average initial weight lbs.	.09	.09	.09	.09
Average 8-week weight lbs.	5.23	5.29	5.24	5.12
Cumulative feed conv. 0-8 wks.	2.00	2.02	2.04	2.04
Mortality	4.90%	3.03%	0.96%	5.83%

Summary of Results of Trial—2

Pen Number	1	2	3	4
Starting temperature	90°	90°	90°	90°
Constant relative humidity	60%	60%	60%	60%
Rate of temperature reduction	1°/day	1°/day	2°/day	2°/day
Average initial weight lbs.	.10	.10	.10	.10
Average 8-week weight lbs.	5.23	5.22	5.06	5.26
Cumulative feed conv. 0-8 wks.	2.15	2.09	2.20	2.13
Mortality	.98%	3.93%	2.94%	2.00%

Summary of Results of Trial—3

Pen Number	1	2	3	4	5
Starting temperature	90°	90°	90°	90°	90°
Rate of temp. reduction	2°/day	2°/day	2°/day	2°/day	2°/day
Average initial wt. lbs.	.09	.09	.09	.09	.09
Average 5 week wt. lbs.	1.97	2.19	2.23	2.07	2.44
Average 8-week wt. lbs.	4.54	4.70	4.58	4.64	4.74
Cum. feed conv. 0-5 wks.	1.83	1.72	1.70	1.79	1.79
Cum. feed conv. 0-8 wks.	1.98	1.95	1.97	1.97	2.07
8-week Mortality	6.00%	1.00%	2.00%	4.00%	3.13%

cent, and in pens 2 and 3, it was decreased to a low level i.e., 40 percent. During this two-week period, control pen 5 was held at 70°F and 60 percent RH.

At the end of the fifth week, all pens were returned to below 70°F and approximately 65 per cent RH.

Growth rate during the two weeks of extreme conditions was suppressed at both the high and low humidities. The maximum suppression in growth rate occurred in the high humidity pen with a lag of an average of 0.42 pounds below the control pen. The average difference between the high and low humidity pens was 0.2 pounds.

After the pens were returned to normal, the depressed pens showed an accelerated growth rate, and by eight weeks of age, had recovered most of the loss. During this stress period, the feed conversion for the high humidity pen was much greater than for the control or low humidity pens.

Only the low humidity pens showed an increase in total water consumption during this stress period. However for the high humidity pen the pounds of water consumed per pound of gain was nearly double the amount consumed by the control pen.

Project RM-1

Application of Energy for Control of Insects

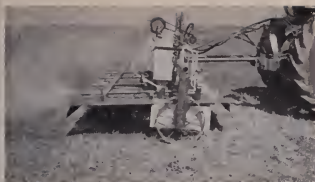
To increase the efficiency of heat application, the experimental flamer was modified. Two centrifugal blowers were mounted on the flamer to supply secondary air under the hood for better combustion. The hood was extended approximately two and one-half feet to increase the length of time the heat was confined. The fuel pressure at the burners was reduced from 30 psi to 20 psi, resulting in a change of fuel consumption of the 15 burners on the flamer from 110 gallons per hour to 79 gallons per hour. The temperature-time curves at two mph were similar to those obtained with the 1965 machine at one and one-half mph.

Treatments were applied to two fields at Clarksville, Maryland. One (field 29) was a 4-year old stand, relatively free of weeds. The second (field 23) was established in the fall of 1965, and at the time of dormant flaming on

March 18, 1966, it contained an extremely heavy cover of chickweed. Control trends were much the same in both fields; however, control of adults, eggs and larvae was lower in the weedy field than the clean field.

Dormant flaming at two mph (March 17, 18) resulted in control of larvae and larval damage equal to the spray treatment of Methoxychlor (1½ lb/A) - Malathion (1 lb/A) applied on May 6. Early harvest alone reduced larval populations to approximately the same level as the dormant flaming at two mph and the spray treatment. Flaming at two mph and spraying of the stubble of the early harvest plots on May 6 were equally effective in larval control.

Results of the field tests indicated that the modified flamer was as effective at two mph as the 1965 machine operated at one and one-half mph. The



Experimental field flamer for control of alfalfa weevil. Fans on top are used to increase available air for improved combustion efficiency.

reduction in operating pressure and the increase in speed of application reduced fuel consumption from 61 to 33

gallons per acre to obtain control as effective as spray treatment.

Project RHB-23

Pneumatic Handling of Chopped Forage

An experiment station bulletin entitled, *Pneumatic Handling of Chopped Alfalfa Hay* was prepared. The report covers the design and development of the systems to transport chopped hay with low pressure, high velocity air; and the investigation of the transportation characteristics within a straight section of horizontal pipe.

The injection of the hay into the air stream was the most difficult problem encountered in the design of the conveying systems. A high speed conveyor used with the field system was the most satisfactory of the several injectors tested. The rate of injection was a function of pipe size, moisture content of material and conveying air velocity. In general, the performance decreased as one or more of these factors decreased. An enclosed screw conveyor performed the best of the injectors used

with the laboratory system. The rate of discharge decreased as the conveying air velocity and moisture content of material decreased.

Major results obtained from the tests designed to investigate the transportation characteristics with the pipe were:

1. A linear relationship existed between rate of material conveyed and the conveying air velocity. The conveying air velocity decreased as the material rate was increased. The moisture content had little effect on the relationship.

2. In general, the pressure drop in the transport pipe as a function of the conveying air velocity was best described with a second degree polynomial regression equation. The pressure losses increased as the pipe size decreased.

Project R-16

Improved Methods for Harvesting Sweet Potatoes

There are known differences in the ease with which different varieties of sweet potatoes can be removed from the plant. There are apparently also differences from year to year for a given variety, perhaps due to weather conditions. It was found that a roller placed over the final separation bar of the deviner on the experimental harvester improved the degree of separation but at some increase in injury.

Plans are substantially complete for a prototype harvester. Present plans are for a two-row, self-propelled machine with attachments for (1) returning the potatoes to the ground for sizing during the normal picking up and basketing process, (2) placing the potatoes in pallet boxes without sizing or (3) conveying the potatoes to truck or trailer without sizing.

Project R-18

Stability of Farm Structures Subjected to Lateral Loads

There is a need to determine whether a pole structure is as satisfactory as a frame structure when subjected to lateral loads. This need has been brought about by the fact that the insurance rate for wind damage coverage is higher on pole tobacco barns than on frame tobacco barns.

Two tobacco barns which were essentially alike except that one was pole construction and the other was frame construction were used in this research. A uniform lateral static load was ap-

plied to the side of a portion of each barn. Deflection was measured at several points in the barn.

Analysis of the data resulted in the conclusion that under equal loads, the columns of the conventional foundation barn showed a greater maximum deflection than the columns of the pole barn. The question remains as to the relationship between wind load and a static lateral load.

Project R-24

Effect on Market Quality of Sweet Potatoes of Injuries Caused by Known Forces

Equipment was designed and constructed to apply abrasive forces to sweet potatoes under known pressure, speed and distance. Tests indicate that Nemagold are much more sensitive to abrasion injury than Nugget or Gold-rush especially at the lowest pressure. Curing at high humidity tends to reduce the effect of such injury on ap-

pearance.

An instrument was designed to subject sweet potatoes to impact forces similar to those encountered in dropping on a digger chain bar. Nuggets were most resistant to cracking in these tests with Nemagold intermediate and Gold-rush most sensitive.

Project R-22

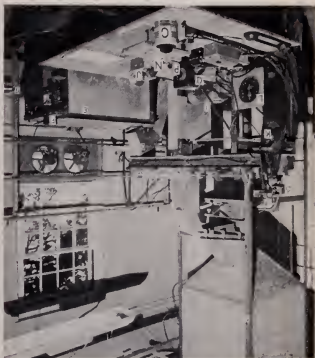
Performance Characteristics of Screw Feeders and Screw Conveyors

Over 2,000 tests have been run using whole barley as the conveyed material to determine performance characteristics of screws in moving materials. In all tests the axis of the screw was horizontal. All screws tested are two inches outside diameter and 24 inches long.

For a good feeder or metering device the output per revolution should be constant over a satisfactory speed range. For the screw systems tested, the shorter the pitch and the smaller the radial clearance between screw and housing the greater the speed range for constant output. With a radial clearance over 0.125 inches or a pitch over 1.75 inches, there was no speed range of constant output.

For a screw conveyor, output in terms of time (pounds per hour), is of interest. For the systems tested, at the lower

speeds, the longer the pitch and the larger the radial clearance, the higher the output.



Equipment used in Screw Feeder Research.



Screws and housings used in screw feeder research. Screws range from 1 inch to $2\frac{1}{4}$ inch pitch in $\frac{1}{4}$ inch increments. Housing range from $\frac{1}{64}$ inch to $\frac{1}{2}$ inch radial clearance in a geometric series.

As the speed increases, the output per revolution for the longer pitches and larger radial clearances decreases more rapidly so that the output in pounds per hour for all pitches in a given diameter housing approaches the same level. For a given pitch the percentage difference in output between the larger and smaller housing decreases with increasing speed but does not reach the same level.

Changing the depth of grain over the

screw axis in the hopper from 4.5 inches to nine inches had only minor effects on output. In general, for the smallest housing, there was a tendency to increase output and for the larger housing to decrease output.

Changing the distance the screw extended into the hopper had a tendency to increase output especially at the higher speeds and for the longer pitched screws.

Project R-25

Construction of Specialized Equipment for Agricultural Research

A number of special test cells were designed and constructed for the "Shear Press" to permit investigation of the

tenderness factors of various parts of a pea.

Project R-21

AGRONOMY

Research in the Department of Agronomy is directed toward the development of improved crop varieties and improved soil, water, and crop management practices that result in more efficient production. Of equal importance is the investigation of the fundamental principles of soils and crops that involve studies ranging from the reactions of fertilizers in soils to the mechanisms of weed killers. The wide range of soils and the 2.3 million acres of agronomic crops (corn, soybeans, tobacco, small grains, turf grasses, hay, and pasture crops) grown in the state with a value of approximately 143 million dollars emphasize the size and importance of the research program in agronomy.

To solve the problems concerning soils and crops, basic and applied research work is conducted at the University, on the University farms and with cooperating farmers, golf course superintendents and others throughout the state.

New Soybean Variety Released

The soybean variety Dare was released by the Agricultural Experiment Stations of Maryland, Missouri, North Carolina, Oklahoma, Virginia, and the Crops Research Division, Agricultural Research Service, USDA. This variety is of Maturity group VI, and is adapted to the upper Delta and Mid-Atlantic area. The variety yields well, and is disease and shatter resistant.

The Dare variety has white flowers, and the seeds have yellow coats. The variety is resistant to purple stain and seed mottling, and to the leaf diseases

bacterial pustule, wildfire, and target spot. It has moderate resistance to phtophthora root rot.

Under Maryland conditions, Dare matures at approximately the same time as the Hood variety. Its seed size is slightly larger than Hood. At Linkwood, in Dorchester County, Dare yielded 4.2 bushels per acre more than Lee and 5.5 bushels more than Hood in a three year average. The oil and protein content of Dare is similar to that of Hood and Lee.

Project B-43

Breeding for Better Dent Corn

The season of 1966 was not favorable for corn production in most areas of Maryland. Extreme drought and high temperatures limited the State average to 36 bushels per acre as compared to a record 74 bushel average for 1965.

Although some experimental field work was adversely affected, useful information was obtained. With half-crop yield levels at Hebron, a 21,000 planting rate showed some superiority over a 16,000 rate as an average for 30 hybrids. Some entries continued to do relatively well with above-normal plant populations

Second year results were obtained for a row-width experiment started near College Park. This experiment was designed to compare yields for 20, 30

and 40-inch rows at two planting rates, and with and without irrigation. Differences between the two seasons were striking. In the more seasonable year of 1965, yield average for irrigation and no irrigation were 147 bushels and 118 bushels, respectively.

A similar comparison in 1966 was 108 bushels for irrigation and 51 bushels for no irrigation. In 1965, the 24,100 seedling rate was superior to the 15,700 rate at both moisture levels. In 1966, the high rate was superior only with irrigation. Furthermore, 30-inch rows gave significantly more production than 40-inch rows at the higher yield levels under irrigation. In 1966, there was no significant difference among row widths.

Project B-50

Breeding of Improved Varieties of Forage Species Adapted to The Northeast

First season yields of experimental orchardgrass strains showed considerable variability. One strain (NE-28-60-1(1)) was significantly more produc-

tive than any of the named varieties in the test. Pennmead, a new variety of orchardgrass from the Pennsylvania Agricultural Experiment Station ranked

seventh in forage production with Poto-
mac and Pennlate varieties ranking 15th
and 24th respectively.

New strains of alfalfa being tested
averaged 0.21 tons above the average of
six named varieties in the test.

A new strain of birdsfoot trefoil

(N.Y. Syn. V15) appears to be more
vigorous than named varieties. Forage
yields over the next several years will
serve further to evaluate this promising
strain.

Project B-56-i

Increase of Beef Production on Midland Pastures With Nitrogen Fertilization and Grain Feeding

Beef production on pasture can be
substantial even in a dry season such
as experienced in 1966. Gains per acre
were good on all Midland pastures,
but yields ranged from 483 pounds
with 200 pounds of nitrogen and no
grain to 885 pounds with 400 pounds
of nitrogen plus light grain feeding.

The effects of nitrogen and grain
were additive. Beef gains produced by
nitrogen were more economical than
those produced by grain feeding.

Slaughter grades taken at the end of
the study showed an increase due both
to fertilizer and to grain feeding. The
latter was more important, showing an
increase of 1.9 points with only 0.4
points increase for fertilization.

Increased production per acre was
due both to higher carrying capacity
and improved individual animal per-
formance. This was true for both
nitrogen fertilization and grain feeding.

Project B-56-j

Wheat Breeding and Evaluation

With the national decline in surplus
grain stocks and the rise in world-wide
needs for more food, wheat is likely to
recover some lost acreage and to justify
better culture on all its acreage. Super-
ior response to high soil fertility with
respect to yield, standing ability and dis-
ease resistance will increase in im-
portance.

Due to high fertility level and an ex-
ceptionally favorable spring season,
yields were high (up to 61 bu. per
acre) at the College Park test location.

Good comparative readings were also
obtained for lodging and mildew in-
fection.

Several experimental lines bred in
soft red winter wheat territory excelled
the widely used variety, Seneca, in straw
strength and low mildew infection. The
new variety Monon from Indiana was
outstanding for straw strength. Several
experimental lines are likely to be re-
leased in the near future.

Project B-66

Varietal Improvement in Barley and Oats

Cooperative efforts with other states
give promise of providing improved
varieties of barley and oats during the
next few years.

With the help of high fertility and

good seasonal conditions for two years
in succession, very useful comparisons
were possible for experimental selec-
tions. The relatively new barley va-
riety, Rogers, had a yield of 92 bushels

per acre. It was out-yielded, however, by three experimentals, all with stiff straw and low mildew infection.

Likewise, the winter oat variety, Norline, used as a check, was out-yielded

by four experimental lines with yields above 100 bushels per acre, all with good bushel weights and good standing ability.

Project B-67

Midland Bermudagrass Hay Looks Good

Research during the past several years has demonstrated that hay yields between 10 and 12 tons are possible from well fertilized Midland bermudagrass hay fields. Chemical analysis of these hays indicate forage of acceptable quality. However, actual animal performance is the best measure of forage quality and must, in the final analysis, be used.

Preliminary feeding trials indicate a large increase in digestibility with earlier harvested Midland hay. Forage samples harvested during the 1966 growing season are now being fed to determine digestibility and intake values of hays cut at different stages of growth when grown at two levels of nitrogen fertilization.

Project B-74

Controlled Climate Helps Understand Plant Growth

To develop better management practices for forage crops, one must be able to understand why plants behave as they do when subjected to various environmental factors. A large amount of data has been accumulated regarding plant responses to specific environmental factors but much of this has been obtained in growth chambers with controlled conditions. Although this goes a long way in explaining specific plant responses, it is difficult to translate these data in terms of yield responses in a "natural field environment.

Equipment for controlling soil temperature in the field has been in operation for the past three growing seasons. Temperature control of the soil

profile to a depth of 12 inches has been within a few degrees of desired temperatures (50, 70 & 90F).

Forage production from two orchardgrass and one timothy variety was more than doubled by maintaining soil temperatures at 50 rather than 90 F. This effect was most pronounced on after-math production. The main reason for this increased yield was due to greater tiller and root development at the cooler temperature. A better understanding of tiller development appears to be one of the main keys to explaining higher yields and stand persistence of perennial forage grasses.

Project B-73



Plant climate studies where the effects of soil temperature in the field on the growth of three forage grasses is being studied. Soil temperatures in each block from front to back were 90°F, 70°F, 50°F, and uncontrolled.

In the 90° block, Potomac Orchardgrass was in the right third, S-37 Orchardgrass in the left, and Climax Timothy in the center. The species arrangement was not the same in each block. Picture taken in early April: Plant responses in mid-summer were also as great, but the trends were reversed with the 50°F plots showing the greatest growth. Cart to left of plots was used to roll over plots to facilitate plant measurements without damaging material.



General view of plant climate study where effects of soil temperatures on the growth of three forage grasses are being studied. Both soil and air temperatures were continuously monitored. Thermocouples at 3 and 12 inches above the soil surface can be seen in each plot. The growth rate of plants marked with the small stakes was measured each week. From left to right, soil temperature of the two plots in foreground were ambient and 70°F, while those in the background were 90°F, 70°F, 50°F, and ambient. Picture was taken in early April. Plant responses were also great in mid-summer but the trends were reversed with the 50°F plots showing the greatest growth.

Pastures Can Be Improved With Sod-Seeding

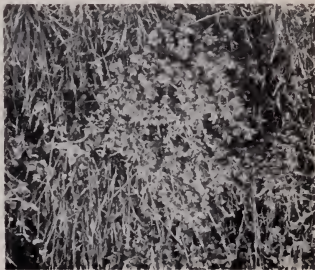
Thousands of acres of permanent pastures in Maryland can be easily improved by introducing legumes into a grass dominant sward without tearing up the existing plants.

Crownvetch, a relative newcomer to the forage picture in Maryland, looks very promising. Crownvetch sod-seeded into bluegrass pasture produced yield increases equal to complete renovation of the pasture to orchardgrass-ladino clover. Birdsfoot trefoil sod-seeded into the same pastures increased yields, but these increases were significantly less

than for crownvetch or complete renovation.

Earlier research at Maryland has demonstrated that the production from Midland pastures can be nearly doubled by sod-seeding cool-season annuals into the existing sward. Preliminary data indicates that the seeding of cool-season perennials is no more productive than the annuals and much more difficult to manage. This comparison will require one or more additional growing seasons for complete evaluation.

Project B-75



Production of permanent pasture significantly improved with sod-seeding. (left), unimproved pasture with low production and a lack of nutritious legumes, (right) Sod-seeded Birdsfoot Trefoil along with Volunteer White Clover as result of sod-seeding. Both yield and forage quality were improved with practice.

Red Clover Breeding Investigations

Selected red clover plants were obtained from a polycross planting in the greenhouse and transplanted into the field to be used as a source nursery for improving red clover persistence as well as other desirable agronomic characteristics. Chesapeake red clover continues to be the best variety for Maryland.

Many red clover plants were crossed with those of Egyptian and Zigzag clover to improve the technique of intergeneric hybridization as well as introducing desirable germ plasam from these latter two genera into red clover adapted to Maryland.

Project B-76

Variety Testing of Alfalfa

The number of alfalfa varieties available on the market has increased rapidly in recent years. This has been due to increased efforts by experiment stations and commercial seed companies to produce varieties adaptable to many special conditions. We must constantly compare these new varieties with the old standbys to be able to make the best recommendations to our farmers.

The present test, in which 24 varieties are being compared, shows that Cayuga performs well in piedmont Maryland,

followed closely by Williamsburg and Narragansett.

Smooth brome grass is a valuable forage species in the mid-west, but has been subject to many fungus diseases in Maryland. New selections from plants better adapted to Maryland conditions are being evaluated at the Forage Research Farm in Howard County. Some of these show promise as they appear to be superior to named varieties being used in the northeast.

Project B-77

Use of Herbicides to Control Weeds in Forages

Several winter annual weeds (wild turnip, peppergrass, yellow rocket) can be controlled by 2,4-DB at 1.5 to 2 pounds per acre. Occasionally, late Fall (November and December) applications of 2,4-DB have resulted in some injury to alfalfa. Gas chromatography analysis of soil samples from 10 locations indicated that toxic levels of 2,4-D may accumulate in soils treated in late fall with 2,4-DB. No build-up of 2,4-D resulted from September or

October applications of 2,4-DB.

The droughts of recent years have made spring seeding very profitable. One of the problems associated with spring seeding is the presence of weeds. Several herbicides including trifluralin, Benefin, SD 11831 and EPTC were applied successfully as a preplant-incorporated for weed control in spring seeded alfalfa.

Project B-79

Late Planting and Winter Survival in Oats

As experimental data accumulate recommendations for crop culture can be made more specific. Time of planting fall-sown oats is a case in point. For six seasons seven varieties have been planted near College Park at intervals of ten days that began about October 1.

On well drained loam soil, the more hardy varieties have consistently accumulated adequate cold tolerance for

this location when planted around October 10, a week later than usually recommended.

Plantings as late as October 20 have consistently survived winters, but have not yielded as well as earlier plantings, probably due to inadequate root and tiller development.

Project B-85

Factors Contributing to Maximum Production in Maryland Tobacco

Varietal and breeding material of Maryland tobacco are being tested under a range of fertility conditions, cultural practices and soil types. Population and N-rate produced significant effects; P-rate did not.

The recently released Maryland 59,

resistant to black shank performed as well as the standard Catterton in yield, price per pound and acre return. Unreleased breeding lines designated J-64-3, J-64-107 and J-64,115 exceeded Catterton in yield but not in quality.

Project B-87

Fundamental Physiochemical Relationships of Tobacco With Respect to Cultural, Fertilization, Curing and Fermentation Practices

In connection with varietal and breeding trials of Maryland tobacco, chemical analyses of the crop were made. Location effect was much greater than intervarietal differences. Tobacco from St. Mary's County had 50 percent higher total nitrogen than from Prince George's County, but no higher alkaloids; tobacco from Anne Arundel County had only 16 percent

higher total nitrogen, but 72 percent higher alkaloids, as compared with Prince George's.

A modification of "compact" curing, known as "pile-yellowing" was made the basis of studies of the effect of chemical treatment on rate of curing. Accelerated losses of pigments and nitrogen fractions may be brought about by these methods.

Project B-89

Effects of Physical Characteristics of Herbicides on Efficiency, and Mode of Action on Corn and Soybeans

Combinations of nontoxic oils with EPTC were synergistic against yellow nutsedge in preemergence greenhouse tests. Paraffinic oils were superior to naphthenic oils and oil No. 11 N (12.8% aromatics) was superior to six other oils tested. Reduced volatility of EPTC + oil in comparison with EPTC alone

may be responsible for the synergism.

Several oils were also synergistic with atrazine for postemergence control of yellow nutsedge. However, the synergism occurred only at high, uneconomical rates of oil.

Project B-94

Seed Germination, Rhizome Development and Control Methods of Johnsongrass

When a perennial weed becomes well established and the rate of distribution increases, it becomes necessary to study the factors involved in its survival and dissemination. Therefore, a study was initiated to determine characteristics and persistence of johnsongrass rhizomes.

Two hundred fifty-eight rhizomes were dug at five locations in the state. These locations varied from the southern tip to the Hagerstown area. Rhizomes, collected at soil depths from zero to seven inches, were measured and tested for viability.

Rhizomes varied in diameter from five to 17 mm averaging eight mm. Lengths varied from 32 to five cm. with an average of 17 cm. Rhizomes, which were collected from an area of one square foot to a depth of eight inches ($\frac{2}{3}$ cubic foot), ranged from 857 cm. to 184 cm. with a total of 394 to 79 nodes; each of which is a potential plant.

On the average, 60 percent of these nodes produced shoots. Nodal interval was about two cm. A rhizome piece as short as five mm. (if it contained a node) could produce a shoot of suffi-



These johnsongrass rhizomes were found in an area 18 inches square to a depth of 6 inches. This represents about 120 potential plants.

ent length and strength to become a plant.

Seed germination percentages of 70, 56 and 14 were recorded, indicating considerable viability. This could account for some of the recent increases in johnsongrass infestations observed when johnsongrass from rhizomes was controlled.

Project B-95

Agronomic Feasibility of Transplanting Tobacco Seedlings in Pressed Peat Soil Cubes

The use of pressed peat-soil cubes to grow tobacco transplants continued to show promise in 1966 as a method of improving tobacco uniformity and reducing the labor peak at transplanting time.

Tobacco plants three weeks after transplanting had grown-off faster and

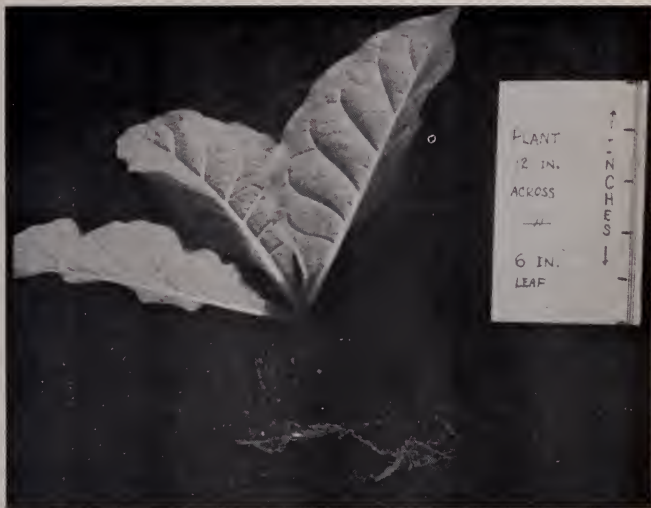
were significantly more uniform where cubed-transplants were compared to conventional transplants. This improved uniformity was noted throughout the growing season and increases opportunities for mechanization of harvest.

Approximately three acres were

planted with cubed-transplants satisfactorily, requiring less than one man-hour per acre to draw plants, whereas

nearly 10 man-hours are necessary with conventional plants.

Project B-96



Smaller tobacco seedlings can be transplanted in pressed peat-soil cubes. These "cubed" plants resulted in markedly improved uniformity among plants and required no labor to pull.

Red Clover Requires Good Management

Red clover and red clover-timothy mixtures cut at the early bloom stage of growth were higher yielding than when harvested prior to bloom or at the late bloom stage. Feeding value of the early cut material was also superior to the late cut forage. The stand life of red clover or red-clover-timothy mixtures were not shortened by early harvesting of the crop.

Timothy seeded with red clover substantially increased forage yields. Where

red clover stands were light because of dry weather following fall seeding, timothy filled in to maintain yields. There were also fewer weeds in the clover-timothy mixtures than with clover alone.

Forage yields were slightly higher when fertilized according to soil test recommendations, but stand persistence was not increased by fertilization.

Project B-97

Physiological, Biochemical Mechanisms of Selectivity of Herbicides

The herbicide chloroxuron was found to be effective against annual morning glory, a serious weed in soybeans. Morning glory is resistant to many currently recommended herbicides. Stage of growth when sprayed influenced soybean tolerance and morning glory control. Radioactive carbon-14 labeled chloroxuron has been obtained and is being used as a tracer to find out why soybean is tolerant, while morning glory is susceptible.

Studies with amiben strengthen the hypothesis, previously suggested by Colby, that a biochemical reaction between amiben and the sugar glucose is the mechanism of selectivity of this herbicide. It was also shown that the aromatic nitro grouping on dinoben is biochemically reduced in plants, thus transforming dinoben into amiben.

A practical consideration resulting from this research is that it may be possible to enhance the selectivity of other groups of herbicides by synthesizing amino or nitro groupings into their structures.

A new formula was developed for mathematically predicting responses of herbicide combinations. The predicted response for a combination is obtained by taking the product of the percent-of-control values for herbicides applied alone and dividing by $(100)^{n-1}$ where n is the number of herbicides in the combination.

Logarithmic transformation of data coupled with an analysis of variance provides a statistical basis for testing synergism, antagonism or additivity.

Project B-98

Factors Related to Irrigation of Tobacco

Supplemental irrigation was not used in the 1965 growing season. Rainfall during June, July and August totaled 8.13 inches, about two-thirds of the 50-year average of 12.57 inches.

Yields dropped 300 pounds per acre, as compared with 1964, while acre

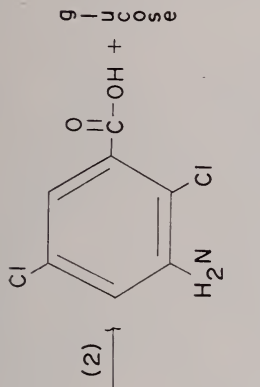
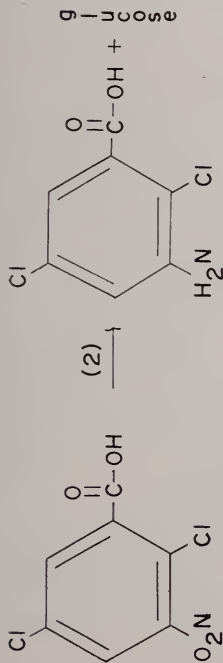
values dropped \$185. This would indicate that a response to irrigation could be obtained when rainfall was less than one inch per week during the growing season.

Project B-99

Effect of Modified Cultural Practices, and Environmental Control of Curing Upon the Adaptability to Mechanization and Quality of Maryland Tobacco

The effect of a single date of topping followed by successive harvest dates was investigated for uniformity of cured leaves within an individual plant. A comparison of yield and quality was also conducted for tobacco of these different stages of maturity.

The most uniform tobacco was obtained where the plant was topped and allowed to mature for eight to 12 days before harvesting. This tobacco resulted in acre values of \$27 to \$100 more than the tobacco from the first date of harvest.



DINO BEN

AMIBEN

N-GLUCOSYLAMIBEN

Figure 1. Biochemical reactions of the herbicides dinoben and amiben in plants.

Where tobacco was topped and harvested immediately, there was a decrease in yield of 8 percent and a drop in quality of 5 cents per pound. The decreased price was marked by poor uniformity. The leaves at the top of the plant were small and greenish with an immature appearance.

Tobacco allowed to mature 24 days after topping tended to "fire" and lost bottom leaves. This overmaturity resulted in a reduction in yield of 18.5 percent.

Project B-101



This "overmature" tobacco lost valuable bottom leaves which resulted in a yield reduction of over 18 percent. Flea beetle damage is also obvious in the top leaves.

Tobacco Breeding, Testing and Quality Evaluations of Maryland Tobacco

New experimental line will be ready for release if proven acceptable to cigarette manufacturing companies.

Line 64-3 has proven to be outstanding in agronomic characteristics and is now being appraised by cigarette manufacturing companies for usability in cigarettes. If line 64-3 is judged as acceptable to these companies it will be released to Maryland growers.

This research has shown that 64-3 has excellent handling characteristics, high yield, satisfactory chemical make-up, good filling power, and pleasing burn and aroma. It produces a high percentage of leaf acceptable as top quality cigarette tobacco.

Line 64-3 is expected to be a very significant contribution to the Maryland tobacco industry.

Project B-103



Experimental line 64-3 has proven to be outstanding in agronomic characteristics and is now being appraised by cigarette manufacturing companies for use in cigarettes.

Tufcote Bermudagrass — Adaptations and Management Requirements for Turf

DMPA (Zytron*) and DCPA (Dacthal*) can be used to control weed competition in newly sprigged Tufcote bermudagrass. They caused no noticeable detrimental effects to the bermuda, whereas simazine injured or killed almost all plants.

Either the preemergence herbicides DMPA or DCPA can be applied two to five days after planting, and will virtually eliminate all germinating weeds. Bermuda, sprigged on one-foot centers in May or June, will produce a complete turf cover in two to three months in treated areas. Untreated areas may

not be completely covered in 12 months or more due to weed competition.

First-year experimental results show that Tufcote should be clipped two or three times per week at a height of $\frac{1}{2}$ to one inch to produce a high quality turf. Higher and less frequently clipped turf was thin and much less attractive. Brown leaves remaining on these plants after mowing were abundant, since most of the green leaves were removed by the mower.

*Trade names

Project B-104

Management of Kentucky-31 Tall Fescue for Recreation Areas

Kentucky-31 tall fescue is an excellent grass for use on playgrounds and athletic fields where foot traffic is heavy, according to second-year experimental results. It should be mixed with other grass species, however.

Kentucky bluegrasses are superior to red fescues as a companion grass. Under similar management conditions during the summer months, tall fescue-bluegrass mixtures produce a more dense

attractive turf than tall fescue-red fescue mixtures. During winter the tall fescue-red fescue turf has a more attractive color.

A new machine has been developed to simulate football player traffic on turf. It will be used on these grasses to determine their resistance to player traffic and rate of recovery after use.

Project B-105

Factors Affecting Turf Quality and Rate of Maturity of Bluegrass-Red Fescue Sod

Turf areas seeded with a bluegrass-red fescue mixture at 50 pounds per acre were invaded by broadleaf weeds to a much greater extent during the early months after planting than areas seeded with 100 pounds.

The same trend was evident following the first application of nitrogen after seedling emergence—plots which received 44 pounds of nitrogen per acre had more weeds than those which received 88 pounds.

A single herbicide treatment 6 months after planting eliminated the

weeds and negated the advantages of heavy seeding and fertilization rates. Plots seeded with 50 pounds of seed were essentially equal to plots seeded with 100 pounds of seed after the first 8 to 12 months.

Sod samples taken to date indicate little difference in population density of turf mowed at 2 and 3 inches, but both had more plants than turf mowed at 1 inch. Turf mowed at the two taller heights rolled and handled better than turf mowed at the 1 inch height.

Project B-106

Effectiveness, and Residual Properties of Several Herbicides Used in Turfgrass Areas

Crabgrass continues to be a serious weed problem in many turf areas. DMPA (Zytron*), DCPA (Dacthal*), and bensulide (Betasan*, Pre-San*) preemergence herbicides have been available for several years and continue to perform well.

Benefin (Balan*) one of the commercially available herbicides has

given almost no crabgrass control at two locations in the state.

Among the new chemicals that are being studied, D-263 is outstanding and SD-11831 is fair. M + B-9057 caused serious injury to both seedling and mature turfgrasses than other weeds, especially crabgrass, invaded the plots.

Annual bluegrass has become a

troublesome weed in Maryland. Many of the preemergence herbicides used to control crabgrass will control annual bluegrass if they are applied in late summer before it germinates. Chemicals with soil residues which last for several months are needed if annual bluegrass and crabgrass are to be controlled from a single application per year. Preliminary results show that bensulide is

the only herbicide which gives this type of control.

A long-term study has been initiated to determine the effect of repeated yearly applications of preemergence herbicides on turfgrasses. Results from this study are not yet available.

*Trade Names

Project B-107

Comparison of Sudangrass and Pearl Millet As Forage for Dairy Cows

For several years we have known that pearl millet depresses butterfat in milking cows. Our recent research findings indicate that this may be tied in with the fertility level of the soil.

We know that the fertility level of the soil influences plant growth, and we now find that apparently fertility does important things to the chemical constituents of the plants which in turn affects the composition of the milk.

We have not yet determined what these compounds in the plants are, but we are comparing the minerals and organic acids of pearl millet and sudangrass under different levels of fertility in an attempt to discover the key to the problem.

Sudangrass is used in the comparison because the growth habits of it and pearl millet are quite similar, and yet sudangrass does not depress butterfat. When this problem is solved an effective



Comparison of sudangrass (left) and pearl millet (right) under: (a) no fertilizer applied, (b) all fertilizer nutrients minus calcium, (c) all fertilizer nutrients supplied.

tool will be available to affect the nutritive value of forages through fertilization of the soil.

Project BG-2

Field and Laboratory Soil Characterization Investigations

Preliminary studies of caves and materials from caves of limestone areas in Maryland have shown that such studies can give information about the nature and genesis of soils.

Parts or all of some shallow caves are

a few feet below overlying soils. Occasional roots of surface plants are found protruding through the ceilings and walls of such caves. Alignment of stalactites along rock joint planes is observed (Fig. 1). This alignment in-

dicates that percolating water at the bottom of overlying soils is channeled down the joints.

Microscope examination of stalactite thin sections shows that stalactites have growth rings. These rings probably indicate seasonal change in the composition and/or rate of flow of percolating waters. X-ray diffraction studies show that secondary carbonate minerals, composing the stalactities, are entirely calcite (CaCO_3), even where the overlying rock contains dolomite $\text{CaMg}(\text{CO}_3)_2$.

Evidence indicates that some caves could be utilized in lysimeter studies, allowing the collection of the percolate from overlying soils. Studies utilizing this procedure could help to determine how well soils filter harmful organisms and chemicals from waters that recharge ground water supplies.

Project O-48



Alignment of stalactites in ceiling of cave, in Hagerstown valley near Rohersville, Md., indicates that percolating water from overlying soil has been channeled into the joint planes of the rock.

Clay Mineralogy of Maryland Soils

The B horizons (subsoils) of Maryland soils, with the possible exception of several eroded soils or very young soils, contain more clay and have higher cation exchange capacity (CEC) clay minerals than corresponding Ap horizons (plow layers). For these reasons clay minerals contribute much more to the cation exchange capacity of the B horizons.

Values for three soil profiles from Anne Arundel County (representing the Monmouth, Collington and Downer soil series) illustrate these statements. These soils contained an average of 18 percent

of mineral clay in their B horizons as opposed to 5 percent in their Ap horizons. The average cation exchange capacity of this mineral clay, in milliequivalents per 100 grams of clay, was 63 in the B horizons and 34 in the Ap horizons.

Considering both factors, the mineral clay contributed an average of 12 milliequivalents per 100 grams of soil to the CEC of the B horizons as opposed to an average of only 1.7 milliequivalents per 100 grams of soil in the Ap horizons.

Project O-54

Soil Test Studies

The clay that occurs in our soils is not all the same. Some clays retain fertilizer elements, while others have only slight retentive properties. Some clays swell in water; others do not. These and other characteristics indicate that the identification of clays is important.

Because of this, a simple, rapid method for clay identification was developed. As different clays have differ-

ent densities and because clay can not settle beyond its own density, a column of heavy liquid solutions of different densities was used for separation and identification.

The settling depth determines the type of clay and the number of different depths occupied by clay indicates the number of different clays.

Project O-55

Effective Use of Soil, and Fertilizer Nitrogen

Summary of the results of a study of ammonium and potassium fixing soils in Maryland indicated that the detrimental influence of potassium on the availability of ammonium fertilizers to growing crops could be reduced by the use of nitrate sources of nitrogen in mixed fertilizers.

A reduction in the fixation capacity of these soils could be related to certain organic compounds. These compounds are released to the soil by the decomposition of crop residues where they separate clay particles, allowing some trapped ammonium or potassium to be

used by plants.

Barley was found to respond to ammonium type fertilizers even in the presence of an abundance of nitrate fertilizers.

Ammonium ions may reduce K uptake by the plants when ample quantities of ammonium are present. A mechanism involved in this reduction is in the interior of the plant.

The magnesium level in corn seedlings may be reduced to a deficiency level if *excess* monoammonium fertilizer is used in the row.

Project O-57

Micronutrient Requirements of Corn on Maryland Soils

Corn produced on land that has been farmed for more than 200 years requires a careful and continuing nutritional examination to predict good fertilizer practices.

Preliminary studies indicate copper in most fields is ample. In fact, plants from 48 percent of the fields showed high levels of copper, and all fields that were examined had plants with ade-

quate copper levels, an indication that further copper fertilizer treatments of these fields is questionable.

Other studies show that plants in 10 percent of the fields examined were low in phosphorus; 13 percent were low in potassium; and 15 percent were low in magnesium.

Project O-62

Effect of Nitrogen, Phosphorus, Potassium on Growth and Development of Forages

Alfalfa is still an important source of forage in Maryland. But, in order to compete with other crops, alfalfa stands must be maintained for as many years as possible.

Many alfalfa stands are lost each year due to a lack of resistance to diseases and winter killing. Initial results from this project indicate that potassium fertilization causes larger and more uniformly distributed xylem vessels in alfalfa roots. This could enable alfalfa plants to better withstand freezing injuries and certain diseases of the vascular system.

Alfalfa plants are being grown at present in nutrient culture solution in the greenhouse. Phosphorus and potassium levels are closely regulated in the solutions nourishing the plants. Microscopic examination of cross-sections of these alfalfa roots will be made in the near future.

Results of this project should greatly increase our knowledge of the roles of phosphorus and potassium in plant nutrition, enabling farmers to produce forages more efficiently.

Project O-64

Nutrient Balance in Orchardgrass as Related to Differential Fertilization

Orchardgrass yields averaged approximately 2.5 tons of dry matter per acre during the dry 1966 growing season. Because of the extremely dry weather, very little growth occurred after the first harvest.

Differences in yields due to phosphorus and potassium treatments were obvious. But magnesium fertilization did not increase yields except slightly on the first cutting. Results indicated

that a response to magnesium would not be likely if soil tests show 30 to 40 lbs. or more of weak acid extractable magnesium present.

When completed, the results of this project will be a valuable contribution to our understanding of how to produce maximum orchardgrass yields for hay and pasture.

Project O-71

Soil Aeration and Crop Growth

Cultivation of corn did not increase the aeration in continuous corn plots on Beltsville silt loam soil. However, this was in an extremely dry year and crusting of the soil was not a problem.

Fourteen measurements were made at intervals of a week during the growing season. The average carbon dioxide content of the cultivated plots was .64

percent and the uncultivated plots contained .63 percent.

Plots that had been in rye-vetch cover crops during the winter, had about the same carbon dioxide content as the plots left bare. Oxygen content of the soil air was reduced about .6 percent which would not affect plant growth.

Project O-72 (NE-11)

Nutrient Requirements of Summer Annuals for Forages

The fertilization of summer annual grasses is being studied to learn the most efficient way to produce maximum forages during the hot, dry summer months. Many of the commercially available sudan-sorghum hybrids are ideally suited to growth at a time when bluegrass pastures are dormant.

Because of the drought during the 1966 growing season, the plots averaged only about 2½ tons per acre from 2

cuttings. No yield differences could be distinguished as a result of differential fertilizer treatments. Moisture was a more severely limiting factor than fertilizer.

In spite of the drought, the summer annuals were capable of producing much needed forage for cattle at a time when growth of other hay and pasture plants was at a minimum.

Project O-73

Response of Corn to Fall vs. Spring Plowing, Broadcast vs. Plow-Down Fertilizer, and Fall vs. Spring Fertilization

Many farmers and commercial fertilizer companies are interested in making more efficient use of their time, labor, and machinery by plowing down a complete fertilizer in the fall for corn the following spring.

Results of this project have so far shown that very little nitrogen was lost by leaching over the winter after being plowed down in the fall. But, the reason for this was that the seasons have been so dry that little leaching losses oc-

curred.

There was insufficient water movement down through the soil to leach surface applied nitrogen even a few inches to the root zone. Under more normal rainfall conditions, nitrogen leaching losses are likely to have been excessive. Knowing the extent of nitrogen losses over winter could save farmers thousands of dollars annually.

Project O-75

ANIMAL SCIENCE

The Department of Animal Science conducts research in the subject matter areas of breeding, nutrition, feeding, and management of beef cattle, sheep, and swine. The fundamental objectives of the Department are to try to improve or to find new methods for producing better animals more economically to benefit directly or indirectly all phases of the livestock industry as well as consumers. Results of the research are published in articles prepared especially for producers as well as in professional journals and technical bulletins of the Agricultural Experiment Station. Other important means of making results available are the cooperative activities with Extension Service personnel and class room presentations for both undergraduate and graduate students.

Fat Mobilizing Factor(s)

Fat is of considerable economic importance to the livestock industry. Meat quality and carcass value are determined in part by the amount and distribution of fat in and around the lean tissue. The fat content of milk is also an important factor in determining the value of milk and the energy required to produce it.

The accumulation and distribution of fat in bodily tissues and the secretion of fat in milk are dependent not only on fat synthesis but also upon the amount of fat which is mobilized as free fatty acids from the depot fat. The rate of fat mobilization is dependent upon hormonal and nervous controls. Isolation and identification of hormones which control fat mobilization and description of the mechanisms through which the hormones are effective may make it possible to employ treatments which would increase the efficiency of meat and milk production.

A factor that causes mobilization of body fat (adipokinesis) has been reported to occur in the urine of a number of species, including sheep. The factor has not been isolated and identified, although it has been reported to be a small peptide. Studies have been conducted with sheep fed a variety of diets and then fasted during periods in which urine was collected.

Tests for activity in urine were conducted *in vivo* with mice and *in vitro* with fat tissues from mice and rats. Fat mobilizing activity could be isolated only from the urine of sheep which had been fed high concentrate diets before fasting. The presence of a net fat mobilizing activity in the urine appears



Lambs on expanded metal "slotted" floor for growth and parasite studies.

to be a response to the stress of fasting after adaptation to diets high in available carbohydrates. In some cases, anti-adipokinetic activity was isolated from fasting urine and the presence of the two activities is indicative of the precarious position of the ruminant in respect to glucose metabolism.

Studies were conducted with urine collected from genetically selected high and low fat strains of boars and results



Pair of lambs on left allowed free choice energy consumption—smaller lambs on right restricted to 75 percent of energy allowed self-fed group.

indicated that the high fat excretes significantly more ($p < .05$) fat mobilizing activity than does the low fat strain. The fat mobilizing activities were further fractionated by gel filtration and the active fractions had molecular weights of less than 400.

Tests for fluorescence and molecular structure give results that are character-

istic of epinephrine. Injection of the active component into rats caused an increase in blood pressure. It can now be concluded that the fraction(s) responsible for fat mobilization and isolable from the urine of fasted sheep and swine is not a peptide.

Project C-42

Moisture Content and Forage Quality

Most hay crop forages average around 80 percent moisture at the proper stages for harvest as hay or silage. The high moisture content of green forages is one of the factors which contribute to the difficulties encountered in making high quality hay crop silages.

Reduction of moisture content by wilting or partial curing to make wilted silage or haylage not only will result in a more palatable silage but also results in a material that is more difficult to store and involves additional machinery and labor in the harvesting process. It has been established that water content per se is not responsible for the frequently observed low quality of high moisture silages and that variations in end products of fermentation during the ensiling process are responsible for differences in silage quality. In the current studies, chopped barley forage was ensiled in steel drums as direct cut (27% dry matter) and wilted (35% dry matter) silages.

Palatability studies were conducted with sheep and dry matter consumption from the wilted silage was considerably higher than that from the direct cut silage. The dry matter of the wilted silage contained more protein ($N_2 \times$

6.25) and less acid detergent fiber (ADF) than did dry matter of the high-moisture silage.

Wilting the forage resulted in a much more limited fermentation as was evident from a higher residual sugar and lower quantities of volatile fatty acids (VFA). Most of the difference in total VFA was due to a higher concentration of acetic acid; butyric acid, frequently associated with unpalatable silage, was not appreciably affected by moisture content of the ensiled barley.

Direct cut or wilted silages were made from chopped alfalfa at pre-bloom stage or Sweet Sioux (a sorghum-Sudan grass hybrid) at bloom stage. A portion



Plastic "miniature silos" used in forage quality studies.

of each forage species was mowed and field cured and stored as hay.

Wilted alfalfa silage (50.4% dry matter) was found superior to all other forages in terms of dry matter intake and live weight gain. This forage was relatively high in crude protein and low in ADF content as compared to the corresponding direct cut silage. Wilting the forage resulted in a more limited fermentation with a lower VFA content and a high residual sugar. As with the barley, most of the VFA differences were due to acetic acid concentrates. The data on Sweet Sioux forages were not consistent with those obtained with alfalfa.

The molar percents of acetate in the rumina of sheep—fed direct—cut alfalfa silage were higher than those in wilted alfalfa silage or alfalfa hay-fed animals. The molar percents of propionate and butyrate in the rumen had an inverse relationship to acetate pro-

duction and forage moisture content. The A:P and A:B ratios in the rumen were decreased as the forage dry matter content increased. The P:B ratios did not justify any definite conclusion. The molar proportions of VFA in the rumina of sheep fed Sweet Sioux forages did not show any consistent pattern.

Results suggested that the wilted alfalfa silage with a moisture level as low as 50 percent had a definite advantage over direct cut silage and, in this case, even over hay from the same crop. Wilting the Sweet Sioux forage to a moisture level of 36 percent in the resultant silage did not result in good silage, probably because of failure to efficiently exclude air. The VFA composition of the silages had no relationship to VFA production in the rumina of sheep-fed silages.

Project C-25-a

Restricted Energy Intake and Growth in Lambs

The effects of restricted energy intake on the growth of young animals have been frequently demonstrated. However, many energy restriction studies, especially with ruminants, also involve restriction of other dietary nutrients. Therefore, it was deemed justifiable to investigate the effects that graded levels of energy restrictions might have on young, growing ruminants when energy consumption is the only dietary variable.

Experiments have been conducted to obtain additional information concerning the effects that energy restriction would have on liveweight gains, volatile fatty acids (VFA) produced in the

rumen, and on various carcass characteristics of lambs receiving isonitrogenous diets at different levels of energy consumption.

Two experiments were conducted to study the effects of restricted energy intake on feeder lambs when complete, isonitrogenous diets were fed. All diets contained 33 percent dehydrated alfalfa meal; the proportions of corn and soybean oil meal were altered as necessary to achieve the desired protein level for each diet. Control lambs were allowed *ad lib* consumption of their diets and restricted lambs received 75, 83, or 92 percent of control consumption.

In both experiments, the effects of

energy restriction on lamb performance was clearly illustrated. Lambs fed 92 percent as much as the control gained as efficiently and nearly as rapidly as the control while restriction to 75 or 83 percent resulted in slow, inefficient growth. It appears, that when isonitrogenous diets are fed to lambs receiving different dietary energy levels, there is a critical level of energy intake which must be maintained if the lambs are to perform satisfactorily. The critical degree of energy restriction, when the lambs are being fed complete diets is about 10 to 15 percent of maximum energy consumption.

The restriction of energy consumption does not materially alter the proportions of ruminal propionic and acetic acid produced. However, the lambs that were fed the complete, pelleted rations generally produced more micromoles of VFA per milliliter of sample than did those lambs that were consuming the complete, ground and mixed rations. It was also noted that those lambs receiving the higher dietary protein levels, relative to energy consumption, produced the highest molar percentages of butyric acid. This situation was particularly evident with the younger lambs.

Carcass characteristics were not affected when the restriction of energy intake was less than 10 percent of maximum energy consumption. However, a severe restriction of energy consumption produced carcasses which were inferior

in almost every respect when compared to the carcasses from the self-fed control lambs.

Thus, these results indicate that moderate restriction of the energy intake of growing ruminants may prove to be advantageous if proper levels of dietary nitrogen are maintained. In a further study, restriction by alternating percents of maintenance and *ad lib* feed allowances was investigated. Severe energy restriction again resulted in slower, less efficient gains and lower quality carcasses. Alternating energy levels have been reported to increase efficiency of fat synthesis in laboratory animals but no such effects could be observed in the lambs in this experiment.

A study of the effects of feeding level and time of sampling upon ruminal VFA in adult sheep was also conducted. Sampling ruminal contents at six to eight hours after feeding resulted in lower total VFA but there were no significant differences in molar percents of the various VFA when results were compared to sampling one or two hours after feeding.

Feeding levels also affected total VFA concentrations but not molar proportions of the individual acids. As has been the case in several other studies at this station, time of sampling and level of feed intake does not appear to be significant factors in determining the molar ratios of VFA in the ruminal contents.

Project C-42

Feed Consumption By Suckling Pigs

Diet formulation for suckling pigs must include consideration of nutrient content and palatability factors. These diets are designed to supplement the sow's milk supply, and thus increase the total nutrient intake by suckling pigs to improve growth rate and efficiency.

The least costly diet to supplement sow milk production is one which is based on corn and soybean oil meal and includes sugar and stabilized fat. The sugar and fat increase energy density but are included primarily to improve palatability. It has been demonstrated that baby pigs consume sweetened supplementary diets more readily and fat improves the diets by reducing dustiness.

A series of experiments have been conducted to evaluate consumption of diets, which include one of the following in addition to corn, soybean oil meal, sugar and fat; dried skim milk, fish meal, dried whey, or oat meal. These additions did not consistently im-

prove feed consumption. The replacement of corn with oat meal in one trial resulted in more consumption; however, when the same comparison was made in a subsequent trial, no difference was noted. Average daily gains or feed consumption relative to gain at 42 days of age were not significantly influenced by diet formulation.

One trial has been conducted to evaluate suckling pig's feed consumption as influenced by age of the pigs at the time supplemental feed is introduced. Comparisons of total feed consumption and gains during a four week suckling period were made between two groups; one of which received supplemental feed at seven to 10 days of age and the other at 17 to 18 days of age. Only a minimal and insignificant additional amount of supplemental diet was consumed by the group started at the earlier age. This did not result in more total feed consumption or greater gains during the suckling period.

Project C-33

Anemia Prevention in Baby Pigs

A study of three schedules for anemia prevention in suckling pigs managed in slotted floored pens has been completed. Previous observations had indicated that feeding uncontaminated soil to suckling pigs stimulated feeding behavior for supplemental feed. The purpose of this study was to determine whether or not the need for supplemental iron exists under this system of management.

A hemoglobin level of eight mg. per 100 ml. of blood is considered adequ-

ate and would not be associated with symptoms of anemia. Valid evaluation of anemia prevention methods must include the frequency of hemoglobin levels below this acceptable minimum rather than an average value for the test group.

The average hemoglobin level for pigs fed uncontaminated soil was 9.7 mg. per 100 milliliters; however, 10.4 percent were below the acceptable level. The injection of 100 mg. of iron dextran raised the average hemo-

globin level and only 1.0 percent were below eight mg. per 100 ml. of blood. A further increase in hemoglobin level was measured in pigs receiving two 100 mg. injections of iron dextran spaced seven days apart, but the increase was not accompanied by a reduction in the percentage of pigs with hemoglobin levels below the acceptable minimum.

These results indicate that the feed-

ing of uncontaminated soil alone does not provide adequate anemia prevention for all pigs. A single injection of 100 mg. of iron dextran, combined with feeding uncontaminated, soil does give protection against anemia equal to that achieved with two 100 mg. injections.

Project C-38

Carcass Characteristics of 200 Pound Pigs as a Criterion for Evaluating Young Pig Diets

Protein quality refers to the level and balance of amino acids in a diet available for maintenance and productive functions. Young pigs, from birth to about 50 pounds live weight, require protein of higher quality than older swine.

Simplified corn-soybean oil meal diets supplemented with vitamins and minerals have been shown to support satisfactory growth during the suckling and weanling periods. However, the question remains whether or not these diets influence the development of muscular tissue during the early stages of growth, which can be measured in carcass characteristics when the pigs are slaughtered at the average weight of 200 pounds.

Partial replacement of soybean oil meal with 10 percent dried skim milk in diets for suckling and weanling pigs has resulted in reduced back fat thickness and a greater yield of lean cuts. These results were observed when pigs were fed diets which provided **minimal** protein allowances of 18, 14.5 and 11.5 percent for the suckling-weanling, growing, and finishing periods respectively.

Raising the protein level to 20 percent for the suckling period and providing less improvement of protein quality with dried skim milk or fish meal, did not result in statistically significant improvement of carcass characteristics, although a trend, similar to that produced by more marked dietary differences, was observed.

Two additional measures of protein status have been initiated. Nitrogen balance is being determined for weanling pigs on dietary treatments of different protein quality. A higher positive nitrogen balance for pigs receiving the higher quality protein would indicate a greater portion of the dietary protein going into muscle storage. Total blood serum protein, serum albumin, and serum globulin are also being measured at various stages of growth. These observations will broaden the basis for interpretation of growth and carcass data relative to the amino acid consumption during the weanling, growing, and finishing periods.

Project C-35

Ovarian Function and Reproductive Efficiency

Reproductive efficiency is a key factor in economic swine production. Variation in litter size appears to be influenced to a great measure by environmental influences, which are difficult to control with our present knowledge. Ovarian function, as it affects ovulation rate and hormone elaboration, is undoubtedly the basis for much of the variation in litter size observed in our swine population.

Study of basic ovarian function has continued with emphasis this year on the contribution of follicles, corpora lutea, and stromal tissues to the ovarian hormonal elaboration. Analyses of blood collected from the ovary following successive destruction of follicular and luteal tissue showed that all three tissues components of the ovary secrete the hormone progesterone.

Approximately 75 to 85 percent of the progesterone is secreted by the corpora lutea and only minor portions of the total are secreted by the follicles and stroma. Further refinement of this technique will be necessary to make

more precise measurements of progesterone secretion of the three components as well as measurements of component secretion rates for the other ovarian hormone, estrogen.

The number of eggs ovulated by both ovaries of female swine during a particular estrous period establishes the maximum litter size potential. It has been noted that surgical removal or alteration of one ovary will result in compensation by the remaining ovary. The compensation is in the form of increased ovulation and hormone secretion per unit of ovarian tissue. Surgical removal of follicles and/or corpora lutea on the left ovary, or removal of the entire left ovary early in the estrous cycle has been followed by observations on and blood collections from the remaining intact right ovary, later in the cycle. It is believed that this approach will provide some basis for explaining marked variations in ovarian activity observed under presumably similar environmental conditions.

Project C-34

Adjustments in Cattle Environment

Data from the herd of a cooperating owner, (Wye Plantation, Queenstown, Maryland) were analyzed in a greater detail than reported last year, plus additional data were added.

Data from 12 years of work, 1954-1965, were used. Age of dam at calving was grouped into 11 ages: 2 and under, 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12 and over. Seasons were designated as : (1) December, January, and February; (2) March and April; (3)

May and June; (4) July, August, and September; (5) October and November; an attempt was made to divide the year by temperature, field conditions, and other related environmental factors.

Weaning weight was studied using the data adjusted for age at weaning. A marked improvement in weaning weight was found from 1959 and 1960 forward in that all of the latter years were above the average for all years.

Averages for 1954, 1960, and 1965, respectively were 448, 501, and 574 pounds. In any breeding project, some time is involved in starting to make progress because of the necessity to orient or re-orient animals, selection methods and genetic material.

Calves born in March and April weighed significantly more at weaning (about 28 pounds) than those born in other seasons. Males weighed about 60 pounds more at weaning than females. Cows three years old and younger and those which were 12 and over weaned the lightest calves. Not too much difference occurred in average weaning weight among calves from cows six to 10 years of age.

Gain during 140 days immediately post weaning and weight at 365 days were studied by correcting all data to a base as if all calves were born in the same year and season; their dams were of the same age; the coefficients of inbreeding were the same for all calves, dams, and sires; and that the calves were all of the same weight, sex, and age

at weaning. This removes the effects of many environmental factors and allows a good comparison of sire's averages.

Wherein sires had at least 15 calves, a difference of 44 pounds in 140-day gain was found between the best and poorest gaining groups of calves. The difference in 365-day weight was 46 pounds.

Weaning weights corrected to the same base as were gain and 365-day weight with the exception, of course, of weaning weight had a difference of 85 pounds between the best and poorest sire groups.

A total of 58 bulls completed feeding trials during the past year. They averaged 557 pounds at weaning, (225 days of age) and 1,005 pounds at 365 days of age, having an average daily gain of 3.12 pounds per day while on feed. The 30 females, which completed their trials, averaged 528 pounds at 225 days of age and 757 pounds when 337 days old, when most were removed from trial.

Project C-39

Significant Progress Found in Performance Studies of Maryland Hereford Herd

The University of Maryland registered Hereford cow herd had its beginning in 1938. The herd was started with five bred heifers purchased from Fox Hall Farm in Catonsville.

Four of the heifers were from the herd of Herman J. Krouse of Alliance, Nebraska, and one from Carl Hahn and Sons of Hay Spring, Nebraska. The heifers were of Prince Domino breeding. They were all bred to Super Domino 19, an International Grand

Champion bull owned by Fox Hall Farm, and all calved in the fall of 1939. The herd consists of 33 head of breeding age.

Prior to the initiation of the present project, the herd was used mainly as a source of experimental cattle. At the start of the present project, the breeding herd was made up of cattle used in previous experimental studies. These replacement females were generally selected on the basis of their performance

in the feed-lot and on their conformation and breed type.

With performance in beef cattle being emphasized to a greater extent each year, this study was initiated to evaluate factors used in selection indices for beef cattle improvement and to use proven research results to enhance the productivity level of the present herd. The present Hereford herd sire was selected on the basis of his conformation, structural correctness, size, and ruggedness.

Actual performance records were not available on this bull. He weighs 2,000 lbs. in breeding condition now as a mature bull. During the years 1963 through 1966, he had sired 78 calves on which weaning data were collected. Thirty-three heifers had averaged adjusted, estimated 205 day weights of 402 lbs. and 45 steers 396 lbs.

To date, yearling data have been obtained on 52 head. The heifers averaged 733 lbs. at 375 days of age and 34 steers 757 lbs. Similar weaning data on 73 heifers and 85 steers produced from 1955-1962 are as follows: averaged adjusted, estimated 205 day weight for the heifer was 435 lbs. and for the steers 437 lbs. Yearling weights on 71 heifers and 85 steers were 677 lbs. and 746 lbs. respectively. All calves (1955-1966) were creep fed and were on pasture with their mothers.

The decrease in weaning weight was probably due to two factors: (1) poor pasture due to the drought; (2) poor milking ability of the cows. The increase in yearling weight of the heifers

by this sire would seem to suggest that his progeny have an increased ability to gain in the feed lot.

Preliminary carcass work indicates that the economic value of carcasses from the progeny of our present herd sire has been increased by raising the USDA carcass grade $\frac{1}{3}$ to $\frac{2}{3}$ of a grade.

One of the objectives of this present study was to evaluate established economic traits and their use in selection indices. The important economic traits now being used most often in indexes are adjusted 205 day weight and grade of the calf. More value was placed on the adjusted 205 day weight. This is logical because the returns to a commercial producer engaged in a cow and calf production program are based on selling weight times price per pound. The decrease in the average weaning weight in our present calf crop suggested that before other production factors of economic value be considered that weaning weight should be given first priority.

A number of cows were culled after weaning their calves. Culling was based on production, age and other factors. In order to widen the genetics base of the herd and to keep the same herd size, performance approved bred heifers were purchased. Work will continue along similar lines. Application of proven research will continue to be used to improve the productivity of the herd.

Similar studies made on the University's Angus herd were reported last year.

Project G-41

BOTANY

Studies of the woodland vegetation of Howard and Calvert Counties was nearly completed. Much progress has been made in the study of the flora of Assateague Island. All these studies will contribute information about the flora of Maryland. Some progress has been made on the manuscript of woody

plants of Maryland. Since it is destined to become a park a bulletin on the Plants of Assateague Island is under consideration.

A study has been initiated on dodders and their anatomical relations to host plants.

Project F-12

Like Chromosomes Essential

Association of like chromosomes from the male and female parents prior to the formation of sperms and eggs is required for fertility. A hereditary factor, *As*, in the longest of the ten different types of chromosomes in corn governs the arrangement of chromosomes into pairs. Our previous research has shown that both parents must contribute *As* for the production of normal, fertile plants. A single dosage of *As* produces sterile plants having unpaired chromosomes.

During the past year, evidence was obtained in regard to the time of action

of *As*. Failure of chromosomal association could be due to an initial absence of pairing of like chromosomes or disassociation after previous pairing in plants having a single dosage of *As*.

Pollen mother cells were observed with initial failure of pairing of chromosome 6. The conclusion follows that normal stocks of corn have *As* in both members of chromosome pair 1, and that fertility dependent upon initial pairing of like chromosomes is controlled by this hereditary factor.

Project F-13

New Systemic Fungicide for Control of Bean Rust

The efficacy of a new systemic fungicide, "Plantvax" (2,3-Dihydro-5-carboxanilido-6-methyl-1, 4-oxathiin-4, 4-dioxide) was tested in field plots for the control of bean rust (*Uromyces phaseoli typica*). This compound was used

as a seed treatment and followed with one foliar application. At the end of the season (early October), rust infection in the control (untreated) plots was almost 100 percent, but there was just a trace of infection in those plots

which had received the "Plantvax" treatment.

This "new approach", the use of a systemic fungicide, offers great promise for the control of bean rust. Extensive research is planned with this compound,

and there is hope that this will lead to the control of this serious disease problem which has been one of the major factors in limiting fall bean production in Maryland.

Project J-91

Possible Sources of Resistance to Sclerotinia Root and Crown Rot of Alfalfa

Screening in 1964 of 30 species of *Medicago* and varieties of *Medicago sativa* indicated that a few, *M. sativa* var. *gaetula* Urb., *M. sativa* L cv Narragansett and *M. tianschanica* Vass. indicated potentially good sources of resistance to *Sclerotinia* species.

In 1965 and 1966 a large number of clones were selected from the three populations above. The clones were grown under controlled conditions and later intercrossed. Cuttings from each clone were inoculated and indexed for resistance. A highly significant difference was obtained in clonal reaction to *Sclerotinia* in eleven out of 82 clones. Results from inoculating the progeny from the polycross seed selections indicated a significant difference in the

progeny of the more resistant and highly susceptible lines.

Further screenings were made of 19 species of *Medicago*, all of which were obtained through the USDA from the following countries: Greece, Turkey, Spain, Uruguay, Poland, Yugoslavia, Denmark, England, Afghanistan, Iran, Australia, Portugal, Argentina, Austria, Algeria and Morocco. Not all species were obtained from all countries.

Three of the species — *M. arabica* (from 3 sources), *M. lupulina* (from one source), and *M. polymorpha* (from 2 sources) had good survival against the *Sclerotinia* species used in the screening.

Project J-93

Treatment of Soil and Underground Parts of Plants for the Control of Plant Diseases

Phytoalexins, those antibiotics produced by the interactions of host plant and certain invading fungi, can be extracted from freeze-dried tissues. Freeze-drying does not damage the activity of the phytoalexin as do other drying methods and such a technique presents a method to determine the amount of phytoalexin produced per unit of dry weight of plant tissue.

When soybeans were inoculated with the soybean pathogen, *Phytophthora megasperma* var. *sojae*, the resistant Harosoy 63 produced seven times as much phytoalexin as did the susceptible Harosoy.

Harosoy 63 differs from Harosoy only by the single gene which confers resistance. To determine if the response of this gene was specifically correlated to

the stimulus provided by the attacking pathogens, the same soybean varieties were inoculated with a non-pathogenic variety of *P. megasperma* and *P. cactorum*, which is also nonpathogenic.

Harosoy 63 produced twice as much phytoalexins as Harosoy when *P. megasperma* was used for inoculation, but there was no difference in amounts pro-

duced by the two varieties when the inoculum was *P. cactorum*.

The widely differing rates of phytoalexin production by the two soybean varieties are dependent upon a stimulus provided by the soybean pathogen or to a much lesser extent by a close relative of the pathogen.

Project J-93

Resistance to Black Shank, Tobacco Mosaic Being Developed in Md 59 and Md 609

The development of disease resistance in Maryland Type 32 tobacco has continued over the past year. Selections that appear to have characteristics of Maryland tobacco have been made in the F_3 generation of a cross between Md 59, a black shank resistant variety, and Catterton. Field appearance of the best selections show characteristics of both parents, the long pointed leaf of Catterton with spreading leaves and not upright as in Md 59.

The leaf is rough and has the characteristic yellowing of Md 59 mature

plants. The plant differs from both in having close thick-set leaf. The selection has a high degree of resistance to black shank.

Crosses of Md 59 and Md 609 with the 41-2 tobacco mosaic resistant variety indicates in the F_3 selfed selections that a high degree of resistance has been introduced into both the black shank resistant varieties without loss of the field characteristics of either Md 59 or Md 609. The TMV resistant crosses were made by the late Dr. Bruce W. Byrd.

Project J-95



Two black shank resistant varieties. Left, Md. 59 and Md. Catterton cross, right, Md. 59.

Physiology, Biochemistry of Nematode and Nematode-Host Relationships

Studies of the kinds and amounts of fatty acids in five species of plant-parasitic nematodes and two host tissues were completed. The C20 unsaturated fatty acids occurring in all nematodes were lacking in host tissues.

Location of double bonds in unsaturated fatty acids of *Ditylenchus triformis* and *Ditylenchus dipsaci* indicated that the major component was vaccenic acid with lesser quantities of oleic acid; while in host tissues (the

fungus, *Pyrenochaeta terrestris*, and alfalfa callus tissue) a major component was oleic acid with only small amounts of vaccenic.

These findings indicate that while nematodes may acquire some fatty acids directly from host tissues, most are probably synthesized in the nematodes. These findings may provide clues to the development of better methods for controlling plant-parasitic nematodes.

Project J-97

Control of Plan Virus Diseases with Chemicals

Studies show that when Southern Bean Mosaic virus SBMV-RNA was incubated with a ribonuclease nearly all infectivity was destroyed. This same treatment only slightly reduced infectivity of the whole virus particle, also leaf ribonuclease reduced infectivity under certain conditions.

A chelating agent ethylenediaminetetraacetic acid (EDTA) reduced infectivity by 99 percent when exposed to virus at high pH, room temperature for one hour, but produced no effect on RNA. Metal ions as Magnesium (Mg^{++}) tended to restore infectivity when added before the ribonuclease or when added with EDTA treated

SBMV.

Experimental evidence suggests that the Mg^{++} ions in the virus subunits prevents dissociation of protein subunits from the virus because it saturates the chelating sites of EDTA and prevents loss of metal ions. The chemical, cycloheximide was also found to inhibit SBMV and SBMV-RNA synthesis.

The research above indicates a possible control measure by use of chemicals that inhibit the synthesis of virus and virus RNA. Chemicals that can control virus diseases would be extremely valuable in agriculture.

Project J-98

Incidence of Pox on Sweet Potatoes

The incidence of pox (*Streptomyces ipomoea*) on sweet potatoes as influenced by two levels of calcium (250 lbs. and 500 lbs. per acre) was investigated in large field plots. The levels of calcium used in this study did not influence pox infection.

Additional applications of calcium will be added to the test areas to determine if higher levels of calcium will influence pox infection at low pH levels. Low pH levels will be maintained with the continued applications of sulfur.

Project J-100

Forest Tree Seedlings, Soil Fungi Relationships

Virginia Pine seedlings can be severely damaged by several soil fungi which cause a disease known as damping-off. As the seedlings become older, they become more resistant to infection so that by the time they are 70 days old, they are practically immune.

Virginia Pine seedlings were inoculated with *Pythium debaryanum*, one of the most serious damping-off fungi. Infected roots of various ages were cut off, sectioned and observed microscopically. The increased resistance could be correlated with an increase in the number of suberized endodermal cells in the pine root.

All root cells except a few scattered, suberized endodermal cells and the lignified vascular cells in roots younger

than 25 days were colonized by *P. debaryanum*. In roots 25 to 70 days old, the incompletely suberized endodermis acted as a partial barrier temporarily restricting the mycelium to cells outside of the endodermis and to those directly inside of the nonsuberized portions of the endodermis.

In roots older than 70 days, the endodermis was fully suberized and was the outermost layer of cells. Mycelium of *P. debaryanum* could not penetrate the completely suberized endodermis, although when this barrier was broken either by emergence of secondary roots or by mechanical wounding, the fungus was able to colonize the cells within the endodermal cylinder.

Project J-101

Maximal Growth of Plants

In automatically-irrigated sand cultures in a greenhouse, an attempt is being made to attain the maximal growth of a given species—namely, the Encore variety (new) of snap bean.

Although certain aspects of the environment cannot be controlled, water and mineral nutrition need not be limiting under the conditions of these experiments. By varying the concentrations of cations and then anions in fac-

torially-designed experiments, it is hoped that even greater plant growth and yield may be obtained in future experiments.

To date, the blade portion of some of the terminal leaflets of trifoliolate leaves measured as much as 9¼ inches in width and 11 inches in length, and the highest yields have slightly exceeded one pound of beans per plant.

Project K-8-c



DAIRY SCIENCE

Application of the results of research on factors contributing to the efficiency of production of foods by dairy cattle, and improving the quality, nutritional value and acceptability of these foods, has contributed to the excellent diet available to people of this state and nation. Much of the knowledge obtained has found application with other economically important animals, animal food products and man. The research results, briefly reported here, represent continuing progress in an attempt to understand natural processes and adapt them for the improvement of human life. They are the most recent developments in a continuing research program which has contributed important factors over the years, and which promises to be even more effective in the future.

Vitamin E And Milk Flavor

As part of a long term study to evaluate the influence of various dairy rations on the incidence of oxidized flavor in fluid milk, the effect of vitamin E (tocopherol) has been extensively examined. Dairy rations which produce milk susceptible to oxidized flavor were found to be low in tocopherol content. The addition of vitamin E to such rations rapidly corrected the problem.

Carefully controlled experiments were conducted to determine the minimum level of the vitamin required to effectively control oxidized flavor. These results have been published and several commercial feed companies are now offering vitamin E supplemented feed to control oxidized flavor.

Additional research is being conducted to determine which natural feeds are good sources of vitamin E and how it can best be preserved. Rapid dehydration or ensiling are both promising methods for preserving tocopherol in forage, and pearl millet and late growths of alfalfa are good sources of the vitamin.



A Graduate Student uses detailed chemical methods to determine the tocopherol (Vitamin E) levels in milk. From this work, feeding programs can be developed which will lead to a desirable flavor in milk.

The research indicates that under proper management adequate vitamin E intake can be maintained with normal dairy rations, thus eliminating the need for vitamin supplementation. However,

vitamin supplementation offers a rapid and relatively inexpensive solution for dairymen faced with marketing problems due to oxidized flavor.

Project G-34

Rapid Detection of Butterfat Adulteration

A rapid procedure for the determination of adulteration of butterfat with vegetable fats has been developed. Levels as low as 0.5 per cent can be detected.

The procedure under development results in the isolation of the nonesterified sterols, which are subsequently analyzed by gas chromatography.

Adulteration is based upon detection of the common vegetable sterol, B-sitosterol. The new method is an im-

provement over present procedures that detect adulteration by analysis of the total sterols present in the sample. The sample work-up time for the new method is approximately 20 minutes, compared to three to four hours for the present procedure.

It is anticipated that the simplicity and speed of the procedure will result in more frequent analyses by regulatory agencies.

Project G-35

Low Cost Gastro-Intestinal Cannulas Made of Silastic

Sampling the digesta of the alimentary tract was made easier with new cannulas. Raw silastic with dacron mesh obtained from the Dow Corning Company, Midland, Michigan, was molded into flexible low cost cannulas

for experimental animals.

The large cannulas were used in the rumen fistula of calves and sheep. The smaller ones were made for use as intestinal cannulas.

Project G-39



Economical plastic cannulas, made of silastic, reduce the cost of research to improve the efficiency of milk production.

A New Kind of Calf

Calves have been surgically changed from ruminants into "pseudo," simple-stomached animals. The esophagus was cut away from the forestomach and sutured to the gastric pouch.

The forestomach was not removed, but backflow into the forestomach was not a problem. The chief problem was

caused by excessive fermentation in the lower tract, since the gas produced by the micro-organisms accumulated and presumably interfered with appetite.

This project is being partially supported by the National Science Foundation.

Project G-37



A healthy calf growing as a single stomach animal will help to increase knowledge about the first 3 compartments of the stomach of cattle.

Heart Bypass Research

Twenty left or right total heart bypass experiments were performed on sheep with the circulatory assist device outside the chest. Greater hemodynamic problems occurred with right heart bypass than with the left heart bypass.

The part of the vascular bed damaged most by pumping was the pulmonary (lung) capillary portion. These experiments were conducted at the Cleveland Clinic in Cleveland.

Project G-37

Electro-Anesthesia and Brevane for Calf Surgery

Excellent safe anesthesia for calves was provided by a combination of electrical anesthesia with Brevane. With electrical anesthesia only about one-third as much Brevane was required during a given surgery procedure.

The Breavane was used for induction and the incision, but was used sparingly thereafter. The electro-anesthesia was begun after induction and was maintained until the end of surgery. Recovery was fast.

Project G-37

Potassium Deficiency in the Lactating Dairy Cow

A pair-feeding trial involving eight individually fed lactating dairy cows was conducted with potassium deficient and potassium adequate rations. The response criteria were the performances and general observations of lactating cows during the potassium deficiency period.

The animals showed a significant drop in feed consumption, symptoms of pica, loss of glossiness of hair coats, a decrease in the pliability of hide, and probably increased body dehydration following potassium deficient periods.

Decreased concentration of potassium in milk and blood was significantly marked during this period, but the proportionate decrease of milk potassium level was greater than that of the plasma potassium. This indicates that the potassium content in the body is being maintained during deficiency periods by elimination of potassium at a reduced rate through milk. However, the potassium concentration in milk

and blood plasma varies significantly between cows. There exists a higher and significant inverse relationship between the potassium and sodium content of milk during deficiency periods in contrast to the adequate period.

The higher negative correlation between potassium and other cations (sodium and magnesium) during this phase leads to a hypothesis that tissue potassium-reserve is maintained to the maximum possible level by reduced potassium and concomitantly increased sodium and magnesium excretion.

The sparing action of sodium for potassium was evident from the greater and significantly positive correlation between these two elements (blood and plasma) and the higher sodium to potassium ratio during the deficiency period. Higher hematocrit readings may be related to the increased body dehydration during the potassium deficient period.

Project G-39

Heated Butterfat in Ice Cream

Results of studies on the use of special heat treated fat in frozen dairy foods indicate that special heat treated fat can be used advantageously as a source of fat in ice milk and ice cream. The special heat treated fat used as the entire source of fat imparted desirable flavor characteristics to the frozen product and resulted in improved storage properties.

The flavor was caramel-like in nature

and was compatible with vanilla, butterscotch, chocolate and other such flavors. Studies made on special heat-treated fats prepared, using heat treatments of 110, 120, 130, and 140°C., indicated that the flavor imparted by the product processed at 120 and 130°C. was preferred by the majority of consumers.

Project G-42



Measurement of the "gloss" of frozen dairy foods is one way that the effect of different ingredients and processing methods on consumer acceptance is studied.

Nutritive Value of Bermudagrass

Intake and digestion trials were conducted with steers on Bermudagrass mays harvested at three intervals. The harvesting intervals studied were 4, 5, and 6 weeks. Average intakes of dry matter were 2.57 percent, 2.55 percent, and 2.11 percent of body weight or the respective cuttings.

Dry matter digestibilities were 65.7

percent, 67.6 percent, and 63.7 percent for the 4, 5, and 6-week intervals, respectively. The apparent lack of improvement with the more frequent harvesting (4 vs. 5-week intervals) appears to be due to the presence of more stolons in the forage.

Project G-47



The energy value of digestibility of forages are determined with the aid of Bomb Calorimeter.

Lipid Structure in Rumen Bacteria

Basteroides rumincola, strain 23, a rumen cellulolytic micro-organism, was grown anaerobically on a chemically defined media. The cells were harvested during the stationary phase of growth. The lipid was isolated by solvent extraction and then separated by a combination of silicic acid and DEAE-cellulose chromatography.

The non-phospholipids (22% of the total lipid) consisted of hydrocarbon, triglyceride, diglyceride, monoglyceride,

and free fatty acids. The phospholipids consisted of phosphatidyl ethanolamine, phosphatidic acids, and a compound that has been tentatively identified as a sphingolipid containing ethanolamine. All major lipid fractions contained over 50 percent branched chain fatty acids.

Enzymatic degradation of the phosphatidyl ethanolamine revealed that the branched chain fatty acids were concentrated in the beta position. This is

interpreted as additional support for the theory that branched chain fatty acids replace unsaturated fatty acids in many rumen micro-organisms.

In addition, it was found that this

organism was capable of synthesizing 15 carbon branched chain fatty acids in the absence of volatile branched chain precursors.

Project G-48

New Reproductive Hormone Discovered

The first direct evidence has been obtained showing the presence of a new reproductive hormone in cattle uterus. The hormone regulates the function and life span of the ovarian corpus luteum (yellow body). For this reason, it has been named the Uterine Luteolytic Hormone (ULH).

Partial purification of this hormone

has been made from Holstein, Jersey and Guernsey cow uteri and the hormone appears to be a protein. The purified hormone may be expected to have human and veterinary clinical usefulness like many of the known purified hormones.

Project G-50

Oral Contraceptive Effects on Reproduction are Examined

These studies have been continued by investigating the effect of an oral contraceptive compound administered to the young female rat. Upon maturity these females exhibited a greatly

reduced fertility. This study suggests that care should be taken to prevent this type of compound becoming available to the young female.

Project G-50

Nutritive Value of Corn Silage

Two experiments were conducted with corn silages from Pennsylvania 602 (early maturing) and Northeast 912 (late maturing) varieties which were grown in low and high plant populations and ensiled at low and high dry matter contents.

Todd 635 variety, medium plant population and medium dry matter content at ensiling time, served as the control. The low and high dry matter silages averaged 24.6 and 35.4 percent dry matter for Experiment I, and

29.8 and 45.2 percent dry matter for Experiment II. Using steers in a randomized design, digestibilities and ad libitum intakes were determined for the 18 corn silages.

The average corn silage dry matter consumption per 100 pounds of body weight for low and high dry matter silage, respectively; was 1.74 and 1.79 pounds for Experiment I and 2.00 and 2.07 pounds for Experiment II. The high population corn silages resulted in greater intakes in the first experiment,



A Scientist studies ways in which the digestion and utilization of forages by dairy cows may be improved.

but there were no differences in the second. No consistent differences in intake could be attributed to varieties.

In both experiments the low dry matter silages were digested to a greater ($P < 0.05$) extent. The energy from these silages was digested similarly to the dry matter. Low population corn silages had greater ($P < 0.05$) energy

digestion coefficients in both experiments, while dry matter digestion was only different in Experiment II. Protein digestion was 34.0 percent and 24.2 percent for low and high dry matter silages, respectively, in the first experiment and 46.6 and 42.6 percent ($P < 0.05$) in the second experiment.

Project G-52

Control of Body and Texture Defects in Cream Cheese

A direct method for the production of cream cheese from cream standardized with nonfat dry milk solids was developed. The resultant cheese possessed excellent flavor characteristics; however, guminess, cracking and bleeding body and texture defects developed.

Heat treatment in the range of 185-195°F. eliminated all defects except the bleeding (whey droplets on surface) phenomenon. Homogenization re-

tarded, but did not eliminate the defect. The addition of 0.4 percent locust bean gum or 0.25 percent locust beam gum and 0.15 percent gelatin or carboxyl methyl cellulose, with processing temperature in the range of 160-170°F, and homogenization at 500 lb/sq. inch, resulted in a product with excellent flavor and body and texture characteristics.

Project G-53

Utilization of Cottage and Cheddar Cheese Whey Solids

Investigations have been initiated to develop usages for the highly nutritious food solids that are waste products of the cottage and cheddar cheese operations. These products consist primarily of high concentrations of milk sugar (lactose) and lower levels of albumin, globulin and mineral salt.

Encouraging results have been achieved in the use of cottage cheese whey solids as a food supplement to

various citrus drinks. Tomato juice, especially juice low in tomato solids, was markedly improved by the addition of these solids. Results of the tomato juice study were basis for recommendations to Food and Drug Administration for approval to permit the addition of whey solids (cottage cheese) to these products.

Project G-53

Analyses of Production and Feed Data from Dairy Records

Maryland lactation records and herd summary records representing several years of data have been obtained from the Dairy Herd Improvement Section, Animal Husbandry Research Division, ARS, USDA in order to:

1. Study the influence of variables such as breed, sire, season of calving, age, weight herd size, and feeding practices on milk and fat production.
2. Relate income to feeding practices,

herd size, production level, and percent days in milk, and study trends which have occurred in regard to these factors.

Analysis of these data should yield valuable information upon which breeding, feeding, and management recommendations can be based. Such analyses could also point to ways to improve the present system of recording and reporting production and feed information.

Project G-54

Insecticide Residues Fed to Dry Cows

A continuing study of factors that influence the absorption, retention, and excretion of heptachlor epoxide residues indicates there is no period during the life of a dairy animal that residue-containing feed will not result in a residue in milk. Mature cows were fed residue-containing hay during the initial part of their dry period.

Results obtained by the analysis of body fat and milk indicated that essentially all of the residue was stored in body tissue and excreted into milk when lactation resumed. The quantity

present in body fat was closely related to the amount excreted into milk. Similar results were previously reported concerning calves and heifers fed residue hay.

Research to date has not indicated a practical means of removing residue from body tissue other than through milk fat secretion. Until additional information is available, residues in milk can best be controlled through a knowledge of the residue content of dairy feeds.

Project G-55

Corn Silage Satisfactory as the Only Forage for Dairy Cows

In the second lactation of a three-lactation study, cows produced as well when corn silage was the only forage fed as when they were given a forage ration of half corn silage and half alfalfa hay. Both groups averaged nearly 14,000 pounds of milk and over 500 pounds of fat on these all year stored forage feeding programs.

Cows that received a limited amount of corn silage (0.9 lb. of silage dry matter per 100 lbs. of body weight) did not show the depressed fat percentage exhibited by those limited to a like amount of alfalfa hay in this lactation, although they did during the first lactation.

Companion studies with corn and alfalfa are being conducted by the Department of Agronomy. This work was seriously impaired by the drought this year. When corn and alfalfa were irrigated, the corn responded with an increase of 80-100 bushels per acre, while irrigation contributed to an almost complete loss of the alfalfa stand.

A dairyman should consider the possibility of relying completely on corn silage as his forage with assurance that the herd's performance will be satisfactory if the silage is properly supplemented with protein, energy and minerals, especially calcium and iodine.

Project BG-3

ENTOMOLOGY

The Department of Entomology endeavors to perfect measures for protecting man, domestic animals, and plants from insect damage. Renewed emphasis is being placed on the use of biological agents for insect control. In addition to research of a practical nature, Entomology staff members are concerned with many problems in the fields of insecticide toxicology, and insect physiology, biology, and classification.

Chemical Control of Insect Pests of Sweet Corn

Research recently conducted on control of soil-borne pests of corn indicates that several new chemicals may have promise as insecticides against such pests.

The soil inhabiting insects specifically which are of concern are at least two species of cutworms, sod webworms, wireworms, and white grubs. Of special interest as possible new tools for control is Dylox, which is currently on the market, and N 2790, a compound produced by Stauffer Chemical Company which is currently being evaluated. Both show promise as insecticides cap-

able of controlling soil-borne insects.

Other materials recently evaluated for control of corn pests include Azodrin, S. D. 8447 (Shell Development), GS 1300S (Geigy), and CP 47114 (Monsanto). These chemicals all to some degree control corn earworm and dusky sap beetle.

Other experiments for control of European corn borer indicated that Sevin and Diazinon are both effective. These materials are both available and appear to be superior to any others tested.

Project H-29-n

Control of Spinach Aphid

The spinach aphid (green peach aphid), *Myzus persicae*, is extremely difficult to control, particularly on overwintering spinach. In the climate of the Eastern Shore of Maryland, the aphid continues to multiply on this crop during the winter. In most seasons winged forms occur and on warm winter days migrate about the spinach fields.

If they are uncontrolled, heavy populations often occur providing conditions favorable for its natural enemies.

Parasites and fungus disease may destroy large numbers of aphids which when dead adhere to the plants so tightly that they cannot be removed by normal washing and processing methods, thus they contaminate the crop beyond usefulness. Also, during the winter months insecticides break down so slowly that prohibitive residues of some insecticides remain on the crop until after harvest maturity is reached. Long-lived insecticides, some of which are highly effective, cannot be used on the winter crop.

Also studies on insecticidal control have shown that effectiveness is reduced by the comparatively low winter temperature.

Since the aphids feed predominately on the underside of the spinach it is impossible to get adequate coverage with usual means of dust and spray applications. Best results have been obtained with short-lived systemics and more volatile poisons.

Future work will involve the use of application methods other than conventional dusts and sprays, utilizing both volatile insecticides and short-life systemics. Methods such as aerosols and finely atomized sprays, that in effect provide field fumigation, may provide better control than now available to growers.

Project H-46-e

Chemical Control of Orchard Insects

Evaluation of concentrate spray equipment as compared with the conventional type of spray equipment was started in 1962 at the Hancock Field Station. Three types of spray equipment have been used to apply from 3 to 33X concentration. One portable machine has been used to apply 1X or dilute applications.

Experiments have demonstrated conclusively that equal control of orchard pests can be obtained with each machine and each concentrate, if the machines are calibrated to apply the same amount of toxicant per tree or per acre. Yearly records on the percent clean fruit from all sprayed plots showed the 33X concentrate to be as effective as the 3X concentrate.

Records made on the percent clean fruit on the sprayed and check plots during 1965-66 showed in all instances

that the fruit on the sprayed plots, regardless of the equipment or concentrate used, was above 95 percent clean. The fruit from the check plots ranged from 8 to 15 percent clean. The control of orchard mites has been satisfactory and about equal with each concentration. No phytotoxicity was observed with any of the concentrates used in these tests.

Grower acceptance of higher concentrates has been encouraging. Several pieces of this new equipment are now in use in commercial orchards and reports from the grower indicate that excellent control of orchard pests is being obtained on both apples and peaches. The savings in equipment and operational costs are as much as 50 percent over those of the conventional type of equipment.

Project H-43

Insecticide Residues in Soil

Investigations have been conducted on the disappearance of Di-Syston and phorate from soil and from spinach grown on treated soil. These two insecticides were applied to the soil at the

Vegetable Research Farm near Salisbury in plots that were seeded in spinach. The applications of the insecticides were made at intervals throughout the winter and the effects of the

changing weather conditions observed.

In the spinach plants themselves, the last treatment, made when the weather was warmer, gave the highest initial residue in the plants, but it was also degraded faster. In all samples, phorate was degraded faster than Di-Syston. Both insecticides were also degraded faster in the soil when the weather was warmer. Very small quantities of unchanged phorate and Di-Syston were found in the spinach. The sulfones, oxidative metabolites, were the materials that appeared in the greatest quantities. Other metabolites detected in the soil

were the sulfoxides and the oxygen analogs of both chemicals. The sulfoxides were also found in the plants, but only small quantities of the oxygen analogs were found in plants. Apparently this material is metabolized faster in the plant than in the soil, or it is not taken up from the soil by the plant.

These studies will clarify the behavior of these two chemicals in the soil during cold weather, and should assist in understanding the metabolism of other organophosphate insecticides under similar conditions.

Project H-67

Alfalfa Insects, Their Biology and Control

Research on the alfalfa weevil has continued with additional testing of short-residue insecticides currently recommended for control of larvae prior to the first cutting. Proper timing in the use of insecticides in conjunction with the first mowing will reduce feeding damage to the initial spring growth and will reduce to some degree the damage to the second growth by late emerging larvae.

Recovery of parasitic wasps of the weevil larvae, *Bathyplectes curculionis* and *Tetrastichus incertis*, and of the parasitic fly of adult weevils, *Hylamodes triangulifera*, through field surveys indicates that these enemies of the weevil are well established in Maryland. The parasite release program, in cooperation with the U.S.D.A., has recently included additional release of *Microctonus* in Prince George's County and *Bathyplectes* in Frederick and Carroll Counties. Biological studies presently are being made on a parasite of adult weevils,



Native spiders feed actively on adult alfalfa weevils. Their importance as biological control agents is being evaluated.

Microctonus aethiops, which is slated for larger releases in the near future. This parasite shows more promise than other parasites presently established in Maryland.

Studies on several species of native spiders as biological control agents have begun. It is planned to determine what effect insecticides may have on spiders and other predators. Certain crab and jumping spiders have been found actively feeding on adult and larval

weevils one week following insecticidal treatments. The possibility of integrating spiders into a program as a valuable adjunct in weevil control is currently being studied.

Project H-71-d

Physiology of Insect Reproduction

When individual male mosquitoes copulate with many females, they rapidly use up all of the sperm in their seminal vesicles and much of the secretion in their accessory glands. The sperm in the testes and in the ducts directly leading to the seminal vesicles are not automatically drawn down to replenish the sperm supply as it is being eliminated.

The seminal vesicles remain mostly empty of sperm for about 48 hours and thereafter refill with numerous spermatozoa. Since the number of compartments in the testes does not clearly reflect this change, it is believed that many compartments are rapidly regenerated.

The reactions of the male mosquito to the virgin female were studied using the forced copulation technique (i.e., the genitalia of restrained males and females were rubbed together under the microscope). The males have four distinct reactions to females: (1) they rapidly and successfully copulate, (2) they seize the female but do not copulate, (3) they show no response to the female, or (4) they actively draw their genitalia away. The females either did not react to males or actively withdraw their genitalia.

Project H-72

Biology of the Mosquito that Transmits Eastern Encephalitis

In the summer of 1965 there were six cases of eastern encephalitis in horses on Maryland's lower Eastern Shore, and in the same area there was an outbreak of the disease in pheasants.

Efforts have been made to obtain additional information about the geographical distribution of the mosquito vector, *Culiseta melanura*. Battery operated light traps were used to collect mosquitoes at strategic locations in areas where the virus is thought to be endemic in birds.

Studies to determine possible food preferences of *melanura* females involved the use of bait traps. Different baits were exposed at three heights in the Pocomoke Cypress Swamp to ascertain if the mosquitoes are more active at ground level or in trees, and if the choice of host is influenced by distance from the ground. Light traps were more reliable tools than bait traps in these host preference investigations.

Project H-73-a



Battery-operated light trap being lowered from tree for morning collection of mosquitoes.

Biology and Control of Insects Attacking Tobacco

The green peach aphid is the most important insect pest of Maryland tobacco and is currently receiving emphasis in research.

There are two systemic insecticides now registered for use against green peach aphid. One of these is Cygon; the other is Di-Syston. Cygon, the first

to be approved for use on tobacco, is a foliar spray that moves into the leaf tissues of the plant and is translocated throughout the plant. There is still more to be learned about Cygon and how it can be more effectively used, and work is now being done to learn more about it. The current work which will help to refine the use of Cygon involves experiments on minimum dosage levels, and the effects of different methods of application of Cygon on its effectiveness.

Di-Syston is a systemic that, when applied to the soil in granulated form, moves up into the plant. As it is with Cygon, the use of Di-Syston can be improved to give better control. In order to do this, it is being tested in side dress applications, and with fertilizer plowed down before transplanting so that methods of application can be compared.

Other systemics which show promise for control of green peach aphid are being evaluated and their properties in the plant studied—such properties as length of effectiveness and rate of uptake as affected by soil moisture.

Project H-74



Green peach aphids, the most destructive insect to Maryland tobacco.

Comparative Morphology, Physiology of Insect Blood Cells

Studies are just beginning on the origins of the blood cells in wax moth larvae. The problem is to find out whether the blood cells arise only by means of mitotic divisions of already circulating cells or whether they are formed by some compact blood-cell-forming organ, or from both simultaneously.

While it is known that blood cells

will divide in the circulating body fluid, the level of this division is quite low. Hourly observations on the mitotic rate of blood cells are being made during the last larval stadium of the wax moth. Histological sections of larvae are also prepared in attempts to locate a possible blood-cell-forming tissue.

Project H-76

Mass Rearing of Insects for Nuclear Polyhedrosis Virus Production

Improvements in techniques for mass rearing of cabbage looper and fall armyworm larvae for nuclear polyhedrosis virus production are being investigated and have resulted in greater efficiency and more consistent results.

Cabbage loopers have in the past been reared on collard leaves in one-gallon ice cream cartons. This method, though more or less satisfactory, was not ideal because of the contamination hazard by the virus and the labor involved in growing, collecting and sterilizing the leaves for food. The cabbage looper and fall armyworm are now being reared satisfactorily on synthetic diets in disposable plastic cups.

The initial switch of cabbage looper and fall armyworm larvae to synthetic diets was very laborious. On hatching, the young larvae had to be transferred by hand with a camel's hair brush to the synthetic diet. This step,

however, has been eliminated by the acquisition of an Anderson Filler and Capper which has been modified to dispense larvae mixed with corn grits onto the diet.

The synthetic diets have the great advantage that disease organisms are more easily controlled. No instance of disease has been recorded in the breeding stock since the changeover.

Whether or not polyhedrosis of the fall armyworm and corn earworm will prove practical is yet to be determined. Field experiments to date indicate that both viruses are effective in the field but as compared to the cabbage looper virus greater dosages per acre and more frequent applications are necessary. The use of polyhedrosis viruses for control of these insects on vegetable crops is desirable since residues resulting from insecticides are not involved.

Project H-81



Time-saving automatic dispensing of artificial diet and larvae.

Pine Coneworm Project

Studies on the biology of the pine coneworm *Dioryctria ametella* (Hulst) have revealed that this insect collected in Maryland has a life cycle of 90 days under laboratory conditions.

The two and sometimes three generations in Maryland have shown no clear-

cut broods or population peaks, but rather an overlapping of generations. The larval or caterpillar stage often goes into an indefinite wandering phase, the length of which affects the time of development of this insect.

Project H-83

Host Preference of Alfalfa Weevil in Relation to Plant Produced Attractants and Repellents

This project attempts to elucidate the factors which cause the alfalfa weevil to attack only alfalfa at economically damaging rates. Two materials have been isolated from alfalfa plant material which attract the weevil over short distances.

The characterization of the chemical nature of these two isolates is in progress. The volatile components of six other legumes (sweetclover, low coumarin, sweetclover, high coumarin, ladino clover, hairy vetch, alsike clover and red clover) were also tested for their attractiveness to the weevil, and it was found that only alfalfa, red clover, sweetclover and high coumarin produced substances attractive to this insect. It was found also that unless the volatile extracts were in aqueous solution, no attractive response was elicited from the weevil.

By a thorough examination of the seven legumes listed above, it was established that only alfalfa and the sweetclovers produced an "egg-laying

stimulant" which is an essential requirement of the diet of the alfalfa weevil if this insect is to lay eggs at normal levels. It was again made evident that this stimulant is either absent from the stem of the alfalfa plant, or else is present in quantities too low to stimulate significant levels of egg-laying or oviposition.

On pursuing further the relative suitability of these seven legumes as hosts for this insect, it was made clear that factors such as suitability as a larval host, adult host, and oviposition host are intimately related, and, if a particular legume is preferred by the weevil for one factor, it will be preferred for all three.

By using 2 x 1 ft. wooden flats, fitted with plastic cages, and infesting each with 600 newly emerged weevil larvae, it is now possible to rear large numbers of alfalfa weevils for experimental work in the laboratory.

Project H-84



A caged flat containing growing alfalfa weevil larvae is placed in these rearing cages for the production of large numbers of adults to be used in laboratory tests.



Dishes containing alfalfa leaf discs used for measuring the actual weight of plant material consumed by weevils. Comparisons of different legumes are made.

Transformations of Insecticides by Plants

The metabolism of the organophosphorus insecticide, dimethoate or Cygon, has been studied in bean plants using several different modes of application of the insecticide. The metabolism of the compound was found to be substantially the same in all the treatments where the insecticide was administered directly to the interior of the plant: stem injection, uptake through the roots, or the use of excised leaves.

Significant quantities of the oxygen analog of dimethoate, the metabolite that is responsible for the toxicity of the compound to insects and mammals, were found in these treatments. Small quantities of another oxidative metabolite, the des-*N*-methyl derivative, that has not been detected in previous studies on the metabolism of this compound, were also found.

Hydrolysis products, the carboxy de-

rivatives, were also found; these are non-toxic metabolites. In contrast to the treatments into the interior of the plants, the treatment to the surface of the leaf yielded a different route of metabolism. Only very small quantities of the oxygen analog were detected and the carboxy derivatives were not found at all. In both types of application several unknown metabolites have been isolated; the investigations of their structures are proceeding.

Investigations dealing with the metabolism of insecticides in plants would be materially aided if a method could be found for studying the metabolism of insecticides in isolated plant cells and sub-cellular fractions. Several systems have been found that look promising and development is continuing.

Project H-85

Biology of Biting Midges of the Genus *Culicoides*

Culicoides, which are also known by the names biting midge, punkie, biting gnat, no-see-um or incorrectly as sand flies are a continuing nuisance in wooded areas and around salt marshes in many parts of the state. A survey of potential breeding sites to determine their distribution and species composition was conducted.

Adults of three species were found breeding in tree holes. These specimens were collected as larvae from various localities within the state and reared to

adulthood in the laboratory. Samples of substrate from other habitats also were brought into the laboratory, but yielded few specimens. The adults were fed on rabbits and suckling mice and later produced numerous eggs.

Techniques for establishing a permanent laboratory colony are being evaluated in order that their biology may be more carefully studied. The statewide survey is continuing.

Project H-86

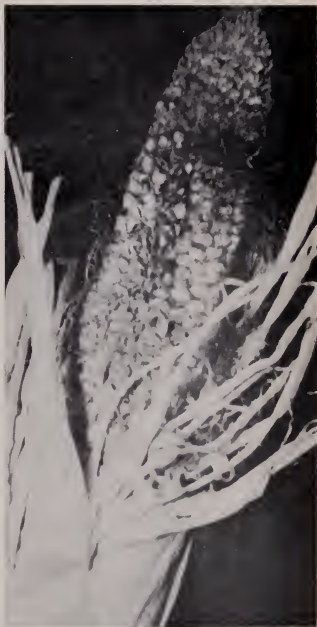
Control of Bird Depredation

Blackbirds continue to be a serious agricultural problem in Maryland. Apparent increases in the numbers of Red-winged Blackbirds, Grackles, Starlings and Brown-headed Cowbirds are probably due to changing agricultural practices. An attempt to alleviate damage to corn has been undertaken in cooperation with the federal government and nine other states.

Corn baited with TEM (Triethylene melamine) was placed on platforms in a selected marsh populated with Red-winged Blackbirds. This drug, used in minute quantities, has been shown to interfere with the reproductive processes of birds without otherwise harming them or disturbing their behavior patterns. Some reduction in nesting success was observed in the treated area as compared to the control areas. A more elaborate experiment will be conducted next year using this promising material.

Trapping and banding blackbirds to study their movements continue to be a part of our project. Evaluating the use of a number of scare devices including plastic owls, broadcasting distress calls, etc. will continue.

Project H-87



Corn damaged by blackbirds on Kent Island, Maryland.



Blackbird decoy trap used in banding and control experiments on Kent Island, Maryland.

Oxidation of Organophosphorus Insecticides in Mammals

Certain organophosphorus insecticides undergo oxidations in mammalian systems that can either activate or detoxify the chemical. Investigations are underway to clarify the relationships that exist between oxidation and the toxicity of the insecticides.

The site where most oxidations take place in mammals is the liver. One can stimulate the liver by treating the animal with certain drugs, among which are the barbiturates. In cases where the liver has been so stimulated, it has been found that the toxicity of phosphorothioate and phosphorodithioate insecticides is increased. On the other hand, compounds which are oxidized at another site on the molecule other than the phosphorus itself, seem to be significantly reduced in toxicity when animals are pre-treated with barbiturates.

This has now been shown by experiments with radiolabeled organophosphates to be due to the production of

oxidation products that would be expected to lend themselves to increased conjugation and excretion by the animal.

Investigations have also been carried out on establishing the identity of certain new oxidative metabolites of several organophosphorus insecticides. Phosphamidon, Bidrin, Azodrin, and dime-thoate, along with several of their non-commercial analogs, have been administered to rats and goats, and the metabolites isolated from the urine and milk.

The oxidation of the *N*-alkyl groups has been extensively investigated and the biological properties of the resulting metabolites are under study. These studies are of great potential value in understanding the effects of drugs and other foreign chemicals on the toxicity of organophosphorus insecticides to mammals.

Project H-90

HOME ECONOMICS

Effects of Blanching Temperature, Storage and Cooking on Frozen Broccoli

1. Conventional blanching of broccoli, three minutes in boiling water, was a better method in general than in water at 77°C or microwave blanching. Microwave blanching did retain more Vitamin C, but color was spotted, a finding thought due to condensation of volatile acids on the broccoli.

2. The total loss of Vitamin C in the frozen, stored cooked broccoli was 52 percent. The greatest source of this loss, 35 percent, was during blanching. Only 7 percent was lost during freezer storage for one year and only 10 percent was lost during cooking. Chlorophyll loss (color) was greatest during cooking, a process which destroyed more than half of the chlorophyll. Freezer storage up to six months caused no loss of chlorophyll. A small loss occurred at one year.

Data from the study on variety and packaging have been calculated but results have not as yet been interpreted or prepared in manuscript form. Therefore the following conclusions would be somewhat tentative:

1. There are significant varietal dif-

ferences in broccoli. Variety E-4200 had a lower pH and higher total acid content than Waltham 29 or Primo. This difference could affect color retention during processing. Waltham 29 had a lower Vitamin C content than either Primo or E-4200. E-4200 was lower in chlorophyll retention than Waltham 29 or Primo, a finding which was obviously associated with the higher acid content of E-4200. These results are for a composite of raw, fresh cooked and frozen samples stored in plastic and polyester bags and cooked.

2. Total acids were decreased from the raw by all cooking methods i.e., fresh cooked and that frozen stored in plastic or polyester bags six months then cooked. Vitamin C retention was greater in frozen broccoli stored in polyester (boil-in-water) bags and cooked than in fresh cooked broccoli or that stored in plastic bags which were removed before cooking. Chlorophyll retention during cooking was again highest in frozen broccoli cooked in polyester bags.

Project Y-3

Further Amino Acid Studies Using Diet Comparison

Proteins differ with respect to their constituent amino acids, qualitatively and quantitatively. Part of the nutritive value of protein is determined by the presence of certain indispensable amino acids.

Although the nutritive value of proteins has been assumed to be related only to the indispensable amino acid content, recent work indicates that dispensable amino acids may have a significant effect on protein quality. In re-

cent experiments, evidence has accumulated showing that the non-specific nitrogen in the diet may increase or decrease the efficiency of nitrogen utilization.

To meet the protein needs of the increasing world population, especially the peoples of newly developing countries, plant proteins will be required in larger amounts. The proteins studied in this investigation include animal protein (meat), and vegetable protein (wheat gluten). One of the objectives is to provide a basis for formulating pro-

tein mixtures of high quality using plant sources that supply the necessary essential and non-essential amino acids.

In 1964, a 30-day metabolic experiment was conducted with eight college women using a diet supplying 0.08 gm of N/kg/day from natural foods, crystalline amino acids and wheat gluten. There were sufficient calories for the maintenance of body weight of the subject (2400-2700). All of the subjects ate the same diet in the same sequence.

This year the 30-day dietary plan



Nitrogen and fat analysis of food composites for human nutrition studies.



Microbiological assay of amino acids for human nutrition studies.

was changed to use a cross-over statistical design on 12 college women. Again the nitrogen intake was 0.08 gm/kg/day from the same sources. The calorie intake was held at 46 cal/kg/of body wt.

Three diets were planned for three successive 10-day periods. The diet was made adequate daily by the addition of a vitamin capsule and a mineral mixture.

For the first 10 days, the protein was from natural foods with a large portion of protein from beef (pre-experimental diet).

After the pre-experimental period, the 0.08 ggon/kg/day was supplied by a basal diet of 3.8 gm of protein supplemented by synthetic amino acids (control diet) or wheat gluten supplemented with synthetic amino acids to make the diet equivalent in amino acids and protein to the pre-experimental diet. These feedings followed a cross-over

design. Six subjects received Treatment A (pre-experimental — amino acids — wheat gluten), and six received Treatment B (pre-experimental — wheat gluten — amino acids).

All twelve subjects remained in positive nitrogen balance through the test periods. Through the 30 days they retained an average of 1 gm nitrogen. Creatinine nitrogen remained constant throughout. For Treatment A the mean urinary urea nitrogen remained constant until the wheat gluten period when there was a decrease. For the group receiving Treatment B, the urea nitrogen increased during the last 10 days.

The level of 0.08 nitrogen per kilogram of body weight was adequate using natural foods, synthetic amino acids and wheat gluten.

Project Y-4

HORTICULTURE

Enriching Greenhouse Atmosphere with Carbon Dioxide for Increased Plant Growth

The small concentration of carbon dioxide found in the earth's atmosphere (approximately 300 ppm) has long been recognized as essential in providing the principle source of carbon for photosynthesis whereby green plants elaborate their own food supply and make growth possible under normal conditions.

There have been many attempts in past years to utilize additional carbon dioxide within the closed atmosphere of a greenhouse to enable plants to produce more food with the resulting increased growth. Increased photosynthetic rates may be obtained in the winter in several ways:

1.) Preventing the carbon dioxide within the greenhouse from being depleted during daylight hours by making additions (whenever the ventilators are closed to conserve heat) to maintain the normal carbon dioxide content of air approximately 300 ppm.

2.) Increasing the level of carbon dioxide in the greenhouse above that present in normal air to make possible an increased rate of photosynthesis on sunny days.

3). Increasing the level of carbon dioxide during periods of low light intensity to possibly increase the photosynthetic rate on such cloudy days.

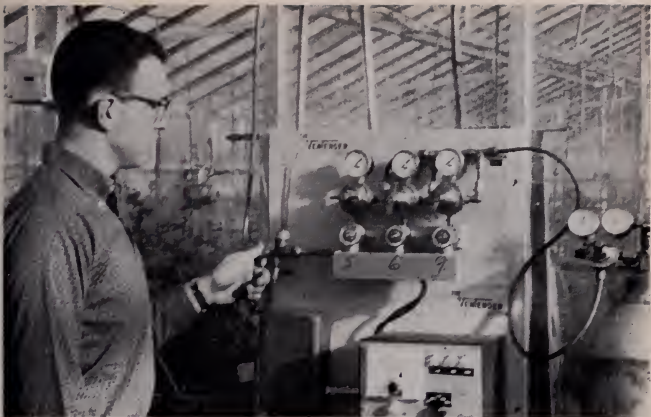
Recent interest in the control and supplementation of carbon dioxide by the greenhouse operators, research workers at several locations over the country, and those interested in selling equipment and supplies made it desirable to test this practice under Maryland conditions using controls not normally found in commercial greenhouses.

A four-year study of adding carbon dioxide to the greenhouse atmosphere in amounts to maintain or slightly in-

crease the carbon dioxide level has just been completed. Paired greenhouses were used to gain untreated checks, one pair for the growth of the warm temperature crop's roses and chrysanthemums, and another pair for the cooler grown crop's carnations and snapdragons. During the second two years of the test, carbon dioxide was injected into the previous control greenhouses, and the former treated greenhouses were used for the untreated controls.

During the months of November through February, carbon dioxide was introduced into the treated houses from 8:30 a.m. until 4:00 p.m. to maintain 300 to 450 ppm, provided ventilation not being required for temperature control. The actual amount added varied with the sunlight intensity, and was regulated automatically at three rates of injection that was controlled by a photocell in the warm greenhouse and manually at two rates of injection for the cooler greenhouse.

A crop of chrysanthemums was grown each year so that growth was made during the time of year that carbon



Equipment for introducing carbon dioxide into the greenhouse at rates to correspond with light intensity.

dioxide was being added and each of the successive four crops responded favorably with increased growth as measured by stem length and combined weight of the stem and flower.

Leaves collected on sunny days from plants receiving additional carbon dioxide contained more alcohol insoluble solids and reducing sugars than from untreated plants when sampled the first year and more reducing sugars, but similar soluble solids when collected the second year.

After four years of trials with snapdragons, in which two varieties were grown each winter season, results showed no consequential differences in the number of days required for flowering, the stem length or the combined weight of stem and flower. No differences were found in the amounts of alcohol insoluble solids or reducing sugars found in the leaves of the snap-

dragon plants sampled in two consecutive years.

The results of four years of trials with two varieties of carnations in which flower production, stem length and weight were recorded during the months of December through March, showed no consequential differences in the number of flowers, stem length or weight due to the addition of carbon dioxide. Also, there was no interactive response of carbon dioxide addition with three levels of soil fertility used in growing the carnations.

In the first year of sampling, leaves from carbon dioxide treated plants contained more reducing sugars, but no differences were found in the amount of alcohol insoluble solids. In the second year there were no differences in reducing sugar content but an increase in the alcohol insoluble solids with carbon dioxide.

Three years trial with three varieties of roses showed slight increases in number of flowers, stem length and stem weight during the months of November through March, but these were not of sufficient magnitude to be of practical significance. Roses, as was the case of carnations, showed no interactive response to three levels of soil fertility with added carbon dioxide.

Preliminary trials, using higher levels of carbon dioxide (1,000 to 1,500 ppm), have been conducted on chrysanthemum, snapdragon, hydrangea, poinsettia, gardenia, geranium, azalea and lily with indications that certain of

these crops respond favorably to this high level. Chrysanthemums showed the greatest positive response. The greater quantity of carbon required to maintain this high level is being obtained by combustion of propane within the greenhouse in burners designed for this purpose.

Large scale, long term trials with roses, carnations and geraniums have been initiated and other crops as lily, hydrangea, azalea and snapdragon will be subjected to the same treatments as facilities and materials become available.

Project I-74-B

Five New Raspberry Varieties Released

Five new red raspberry varieties resulting from the breeding program were released for commercial propagation during the year.

These exhibit differences in season of ripening and greater adaptability to Maryland soil and climatic conditions. They especially represent significant improvement in survival to Maryland's

fluctuating winter temperatures which heretofore have limited profitable production of the crop in the Appalachian counties of the state.

An indexing program for the maintenance of virus-free foundation stock has been established in conjunction with commercial nursery-stock production.

Project L-73

New Training System for Apple Trees

In an investigation of new training systems for apple trees, several systems were evaluated on standard Delicious trees for insuring a strong structural framework, and at the same time, avoiding large pruning cuts after trees had reached considerable size.

One of the better systems, that of headed interscaffolds, involved the selection of four permanent branches or

leaders at the end of the second growing season, and the heading back of all others (see illustration). No further decisions had to be made on the identity of the scaffold structure, and interscaffolds were retained but kept in check by annual heading back, whereas permanent leaders were given only minor corrective pruning.

In this manner, interscaffolds were



Headed Interscaffold training system on standard Delicious apple trees showing before (left) and after (right) pruning on the same tree in the 2nd (top), 3rd (middle), and 5th (bottom) year.

temporarily used to provide leaf surface to further nourish and build the tree, and to minimize the dwarfing influence of pruning cuts that had to be made. When the trees came into bearing, the headed interscaffolds were gradually removed without having to resort to major pruning cuts. By this time the

trees exhibited a strong basic scaffold structure with acceptable crotch angles capable of bearing fruit for many years. Yield records obtained through the tenth season showed that these trees have yielded well despite rather severe early pruning.

Project L-74

Dwarf Fruit Trees from Chemicals? Not Yet.

Investigations have been conducted with the new growth retardant N-dimethylamino succinamic acid (B-9) to determine the possibility of containing apple tree size with this chemical.

Concentrations of 625 to 10,000 ppm were sprayed on four-year-old Delicious trees when growth was just beginning in the spring, when seven inches of terminal growth had been achieved (after 21 days), and when 14 inches of terminal growth had been reached (after 36 days). Weekly growth measurements indicated that dramatic growth suppression had been achieved at the higher concentrations, but only when the compound was applied on April 23, or when growth was just beginning.

When 14 inches of growth had been accomplished before the application of B-9, no measureable response was found. Early applications of B-9 resulted also in significant reductions in

caliper of terminal shoots and the total number of leaves, but significant increases in the number of leaves per unit length of shoot growth and in flower bud initiation. B-9 sprays resulted in no differences in the dry weight or size of leaves, regardless of when it was applied or at what concentration.

Extensive investigations in the two seasons since these marked differences were recorded have shown that subsequent control of growth with B-9 sprays is markedly inferior to that achieved in the first season. Further, clear evidence has been found that apple fruits were also reduced in size by B-9 sprays. Multiple sprays of low concentrations of B-9 have not resolved this or other apparent problems connected with using this chemical on apple trees.

Project L-74-c

Peaches After Harvest

If a "ripe" peach means a soft peach of optimum texture for eating, then the consumer seldom, if ever, gets "tree-ripened" peaches. Peaches must be picked at a sufficiently firm stage to withstand the necessary handling between harvest and consumer use.

Softening of the fruit is the result of a complex series of biochemical reactions with the rate greatly affected by temperature. In storage studies of three varieties, Redhaven, Halehaven, and Redskin, no softening took place in 32°F. in storage. After subsequent ripen-

ing at 65°F., little or no deleterious effect on the appearance or flavor of the fresh, canned or frozen product was noted in fruit stored one or two weeks. Three and four weeks storage resulted in "mealiness" of the fresh fruit and darkening of the processed product especially in the variety, Redskin.

Attempts to prolong the storage life of peaches by altering the storage atmosphere have not been very success-

ful. Reduction of the oxygen content to levels (1%) effective for increasing storage life resulted in anaerobic conditions and alcoholic type flavors. It was found that increasing the carbon dioxide content of the storage atmosphere to five percent decreased the rate of development of the "mealy" condition.

Project L-79-F

Respiratory Drifts During Ripening of Peaches

Many fruits undergo marked changes in the respiratory rate during the ripening period, with the rate reaching a peak which often coincides with the stage of optimum edibility. Such a change in respiratory rate has been termed a "climacteric," and fruits exhibiting such changes, climacteric fruits. Production of ethylene by the fruit is generally associated with the climacteric, and so, with the softening or ripening process.

The respiratory activity and ethylene production of harvested peaches of several varieties was determined during two seasons. Rates were determined on individual fruits. No consistent change in the rate of respiration measured either by carbon dioxide evolution or oxygen consumption was found during an eight-day ripening period of 65°F. or until the fruit had passed the edible stage.

Ethylene production was detected in all fruits at time of harvest, with rate of production increasing during softening of the fruit, and reaching a peak coinciding approximately with the optimum edible maturity stage. Ethylene production during the ripening period closely followed a trend typical of the climacteric curve, rising to a peak and then falling at the end of the storage lift.

However, the failure to find any consistent change in the respiratory rate would class the peaches used in these tests as "non-climacteric" fruits. Ethylene production by fruits on the tree was detected several days before a commercial harvest time, but at a rate far below that of soft ripe fruits.

Project L-79-F

Reducing Strawberry Fruits Rots with Controlled Atmosphere Storage

The effects of low temperature plus controlled atmosphere storage (CA) on the development of *Botrytis* (grey

mold) and *Rhizopus* (soft rot) are being studied. The possibilities of extending the "shelf life" of the berries while

in supermarkets are also being evaluated.

Lowering the oxygen content of the storage atmosphere from 21 percent (normal oxygen content of air) to four percent reduced *Botrytis* from 9.7 percent to 4.8 percent during three-day storage tests. After removal from storage, fruit held under simulated supermarket conditions for two days developed a total of 14.7 percent *Botrytis* when previously stored at four percent oxygen and 28.7 percent when stored at 21 percent oxygen. Under similar tests, *Rhizopus* control was effective only for one-day storage periods and the following supermarket tests.

Reducing storage temperatures from 70°F. (similar to non-refrigerated transportation) to 32°F. reduced *Botrytis* 22 fold during three-day storage tests. In the following supermarket test at 70°F. for two days, 2.8 percent

of the berries previously stored at 32°F. developed *Botrytis*, whereas 43.1 percent was infected when previously stored at 70°F.

Under similar conditions, *Rhizopus* was reduced 44 fold in storage by lowering the temperature from 70°F. At the end of the following supermarket tests, berries previously stored at 32°F. had developed a total of 1.9 percent *Rhizopus*, whereas the berries previously stored at 70°F. had developed 86.9 *Rhizopus*.

Both *Botrytis* and *Rhizopus* increased three fold during the two day simulated supermarket test regardless of previous treatments. This underscores the importance of keeping disease infection at the lowest possible level during shipment. Refrigeration even for "short haul" eastern U. S. conditions is important.

Project L-79-G

Acid Control in Processing Tomatoes

Successful processing of tomatoes and tomato products depends on control of acidity of the product. If the processed tomatoes are not sufficiently acid they may spoil. On the other hand if the product is too acid its taste is not acceptable.

The Food and Drug Administration is considering permitting the addition of organic acids to increase acidity of canned whole tomatoes to a pH level of 4.1 to 4.3, which would meet the above requirements.

It would be desirable to control the acidity without the use of additives. Work was therefore undertaken to determine if such control could be obtain-

ed by electrodialysis, a method similar to one used for desalination of water. The results obtained thus far by the use of an ion modification unit indicate that by the removal of the potassium ion through electrically charged screens, tomato juice could be acidified at least one hundred fold, without materially altering appearance or color of the juice.

It is therefore possible to divert as little as one or two percent of the total tomato product through such an ion modification unit, reblend it with the main stream of product, and thereby acidify it to the desired level.

Project Q-58-M

Quality Processed Sweet Potato Affected by Can Type

In recent years, processors have encountered problems of can corrosion with certain vegetables processed in tin-coated cans. The problem with sweet potatoes became so acute in certain areas that processors have changed to the use of enamel-coated cans.

In tests comparing the processed product from tin-coated or "plain" with that from enamel-coated cans, the more attractive color and appearance of the product from the plain can was evident. This difference was found in a number of comparisons and with different types of tin and enamel coatings. Sweet potatoes from the plain cans were invariably brighter in color, of a clearer shade of orange, and lacking in the darkening or graying that was present in the enameled cans.

Darkening of sweet potatoes during preparation for and during the processing procedure is caused by the action of the polyphenoloxidase system present

in the roots. It is assumed that the tin coating on the cans acts as a reducing agent in preventing the accumulation of the dark colored compounds or perhaps by reducing those already formed. In enamel-coated cans, this action of the tin is effectively prevented, and a less attractive colored product results.

Processors have depended upon this "bleaching" action of the tin coating to improve the appearance of sweet potatoes that have undergone darkening during the processing period. This "bleaching" will not occur in enameled cans. Experimental packs have shown that various additives will act similarly to the tin coating in enhancing the color of processed sweet potatoes but; until such additives are approved for use, the sweet potato processor must take extra precautions to prevent darkening during processing if enamel-coated cans are to be used.

Project Q-58-N

Tracer Technique Determines Efficiency of Calcium Firming Plant Tissues

Calcium chloride ($\text{Ca}^{45}\text{Cl}_2$) can be used as a tracer to determine the efficiency of Calcium (Ca) firming during a canning or freezing operation. Penetration of Ca into the tissue must be complete for the most efficient firming of soft apple fruit. Other fruits and vegetables benefitting from Ca firming are tomatoes, cherries, cucumbers and sweet potatoes.

This procedure of employing radioactive Ca should also be useful to de-

termine the efficiency of the various processing operations where plant tissues are treated with Ca salts.

Dipping or soaking apple slices in a Ca^{45} solution allowed only the surface of the fruit to receive Ca, while processing slices in a Ca salt medium produced similar results. A vacuum-pressure process was most satisfactory for the slices and indicated an even distribution of Ca salt in the tissue.

Project Q-58-p



Autoradiograms showing apple slices with inadequate penetration for best Ca firming. (Dark areas indicate Ca^{45} penetration.)



Autoradiograms showing apple slices with deep Ca^{45} penetration and excellent firming.

Fingerprinting Apple Fruit Cell Walls

Gas-liquid chromatography (GLC) has become an easy method to fingerprint fruit cell walls and determine the potential for firmness and other aspects of texture.

These procedures may be used to check breeding stock characteristics for the fresh market and processing, to evaluate changes occurring during maturation and storage, and to better utilize plant cell walls for the nutrition of humans.

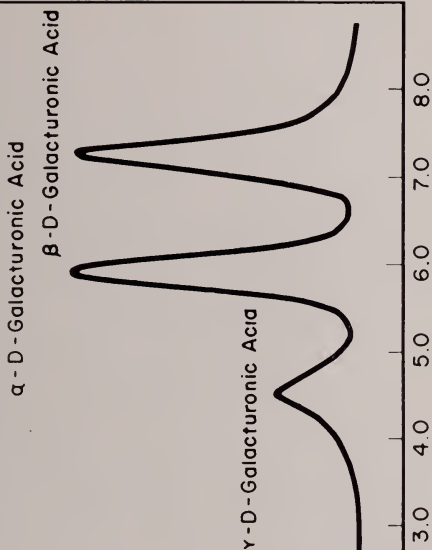
A new technique for preparation of sugars for GLC, using hexamethyldis-

ilanzane and trimethylchlorosilane (TMS) makes reducing sugars and sugar acids quite volatile. By determining the monomers of polysaccharides in fruit cell walls, one can reconstruct or fingerprint cell wall components.

The gas chromatograms indicated the method was about ninety-nine percent efficient in recovery of TMS sugar derivatives. Apple pectin for example, was found to contain three anomers of D-galacturonic acid.

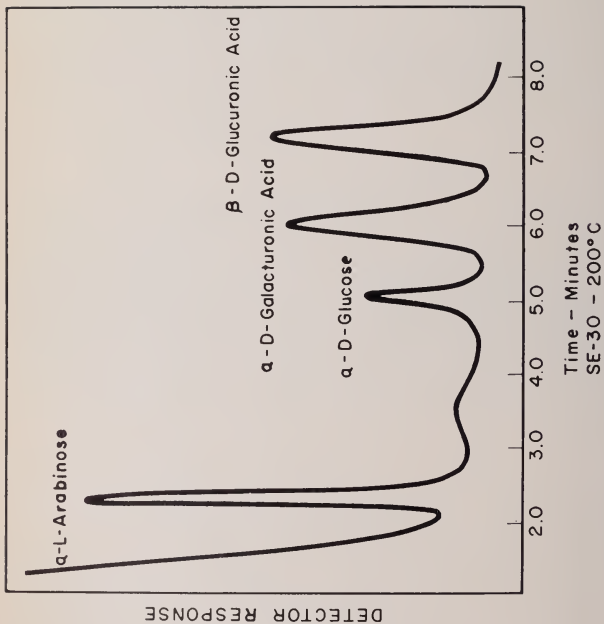
Project Q-58-p

DETECTOR RESPONSE



Time - Minutes
SE-30-200°C

TMS derivatives of sugars from polysaccharides in apple and other fruit cell walls.



TMS derivatives of D-galacturonic acid from apple cell-wall pectin.

Effects of Day Length and Temperature on Broccoli

Green sprouting broccoli was grown in growth rooms under controlled temperatures and day lengths. A day temperature of 75°F and 60° at night produced more desirable growth and better quality heads than either higher or lower temperatures.

At a day temperature of 85°F and 70°F at night, the vegetative stage of growth was prolonged and the appearance of flower heads was delayed. The heads were undesirably leafy and of poor quality at these high temperatures with many of the blossom buds turning brown and dropping off. Exposure to low temperature in the early stages of development followed by favorable warm temperatures induced uniform heading with all plants heading at near-

ly the same time.

A 16-hour day enhanced vegetative growth but delayed head initiation as compared to a 12-hour day. The incidence of hollow stem was greater under the long day, at high temperatures, and with high levels of nitrogen.

In general, hollow stem was found only in the larger plants under conditions favorable for rapid vegetative growth. Microscopic examination of tissues in plants with hollow stem indicated that the pith has ruptured, probably giving way to strains generated by rapid growth and the differential rates of growth between the central and peripheral cells of the pith.

Project Q-77

Herbicide Combinations for Vegetables

Most herbicides being used in vegetable crops today are highly specific. That is, they selectively kill or injure certain plant species while not affecting others.

The ideal herbicide then, would be one that controlled all the weed species and had no effect on the crop being grown. Unfortunately, such herbicides do not exist. A given chemical may control many weed species, but invariably some seem to be resistant. Such species left unchecked quickly multiply due to the reduced competition from other weed pests. Combinations of chemicals according to the weeds present may ultimately solve this problem

chemical combinations is being accumulated from experiments conducted at the Vegetable Research Farm. Herbicides are applied with a logarithmic sprayer at varying rates which reduce by one-half every 15 feet the sprayer travels. This allows the determination of the minimum amount of chemical that will control each weed species and the maximum tolerated by various crops.

Using this information, chemicals can be selected for herbicide combinations. These are then further evaluated and may ultimately lead to more efficient, broader spectrum weed control in vegetable production.

Information helpful for selecting

Project —Q-77-B

Sweet Corn

Several sweet corn varieties were resistant to both earworm and sap beetle damage when evaluated under natural infestation at College Park. Husk tightness and husk extension beyond the tip of the ear was not associated with resistance to either insect. However, the formation of a "silk ball" at the ear tip was associated with resistance in regard to the extent of ear damage and the number of ears infested.

Unfortunately, the silk ball character is also associated with more undeveloped kernels at the ear tip. The extent of blank tip varies among lines so it seems possible that resistance and an acceptable amount of blank tip can be in-

corporated in new varieties.

Combining insect resistance, bacterial wilt resistance, and *Helminthosporium turcicum* resistance with desirable table quality factors was started in 1965. Knowledge of the factors related to resistance will aid in making insect resistant selections for the development of resistant hybrids.

The question of why silk balling imparts resistance is now being studied. Silk-balling is associated with mortality of earworms so that it is possible that a lethal biochemical substance is present in the silks of unpollinated resistant lines.

Project Q-81-C

Tomato Breeding

The development of machinery for mechanical harvesting and bulk handling of processing tomatoes has intensified the need for varieties suitable for a mechanized industry.

The most important factor in growing tomatoes for mechanical harvesting is uniformity within and between plants. The basic requirements for obtaining this uniformity are varieties having a concentrated set and the knowledge of how to grow these varieties for a once-over harvest. The latter factor is important since the inadequacy of current cultural practices has been established.

The development of mechanical harvest types has been emphasized in the breeding program at the Maryland Station. Specific crosses involving the factor's shape, firmness, color, crack resistance, soluble solids, high acidity, con-

centrated set, vine size, and jointless pedicel have been made, and a selection and evaluation program has been followed for the subsequent generations.

Two promising dwarf lines, 6404 and 6405, and several promising determinate types have resulted from this program. Work at the station and in cooperation with growers has been conducted to evaluate breeding lines and varieties and to determine the cultural practices best suited for the area.

Research programs have been initiated to screen for resistance to anthracnose, early blight, gray leaf spot, Verticillium wilt, and Fusarium wilt because resistance to these diseases is especially important for mechanical harvest type tomatoes. Resistance to anthracnose has been found in two plant introduction lines. Crosses between these two lines and several com-

mercial varieties have been made in an effort to determine the inheritance of resistance and to transfer the resistance

to the varieties.

Project Q-81-D

Effect of Traces of Oxygen and Other Gases on Preservation and Flavor Development of Plant Materials

Food materials are preserved by the destruction, inactivation, or attenuation of microorganisms and enzymes. Frequently, the ultimate goal is to accomplish such preservation without changing the natural quality characteristics of the food. The conventional "canning" process is an effective means of preserving many food materials by the application of heat in combination with packaging in hermetically sealed containers. The resultant product, however, usually differs considerably from the natural raw material.

Preservation by freezing or dehydration are also effective and widely used, but such procedures also tend to change the natural quality of the raw materials. Such changes may be minimized in

some instances but at high cost. The only new method of preservation is by irradiation, which is also limited because of quality and cost problems.

The partial removal of air (oxygen) is widely practiced as in the case of vacuum packing and controlled atmosphere (CA) storage. In some instances such practices have resulted in undesirable quality changes because of anaerobic respiration and other disruptions in normal physiological activities. In other instances reduction of the oxygen levels in the atmospheres surrounding the foods to no more than three percent to one percent, did result in substantial prolongation of shelf-life.

These findings suggest the possibility that for some products under appro-



Fresh potato plugs after one month storage at room temperature. From left to right: SO_2 , or CO flush + ethylene oxide; ethylene oxide flush + ethylene oxide; nitrogen or CO + nitrogen; control-prepared and stored in air; nitrogen flush + air storage.

prate conditions, there would be little or no opportunity for deteriorative changes if the oxygen could be removed entirely or replaced not only from the space surrounding the food particles, but also from within the particle itself. Another possible result of such a process would be the initiation of new and different kinds of physiological activities which would result in new and different flavors in these products.

Near total removal of oxygen from sliced and diced potatoes and apples prevented color change but only delayed changes in texture and flavor. Additional treatment with carbon monoxide and hydrogen cyanide further delayed textural breakdown (enzymatic), but

had little effect on anaerobic microbial multiplication and resultant off-flavor development. Treatment with ethylene oxide had the desired bactericidal effect.

It therefore appears that a combined treatment whereby atmospheric and internal oxygen is withdrawn to be replaced by a combination of gases having a biostatic or lethal effect on both enzymatic and microbial activity may provide a means of preserving quality of fresh fruit and vegetables without the use of heat, color, or irradiation, thereby preserving the product without imposing a cooked flavor, or changing color or texture from that existing in the natural state.

Project Q-84-a



Isolation chamber used for preparing fresh peeled vegetables and flushing with various gases.

Preservation of Fresh Vegetable Quality by Gas Exchange

Foods are preserved by the destruction of micro-organisms and inactivation of enzymes. This is conventionally done by means of canning, freezing, and dehydration.

All of these methods, however, tend to change the natural quality of raw material. The new method of irradiation is also limited because of quality and cost problems. When oxygen is withdrawn from the atmosphere surrounding the fresh food, there is an extension of shelf-life because enzymatic activity is reduced. However, there is no preservation effect.

In this study a successful method of preserving fresh peeled apples and potatoes indefinitely was obtained without changing quality by first inactivating enzymes with carbon monoxide or sulfur dioxide, and then destroying micro-organisms by using ethylene oxide.

Apparently, it is essential to inactivate enzymes first since these products not only brown but turn black. For the process to be successful it was important to first evacuate the oxygen present within the food particle.

Project Q-84-a

POULTRY SCIENCE

The research program of the Poultry Science Department consists of a combination of fundamental and applied projects. Since the Poultry Department is primarily to serve a commodity interest, naturally much of the research is of an applied nature. Several of the staff members have dual appointments with research and extension areas, and thus the department has good firsthand contact with the industry, and is continually appraised of its problems.

The work is divided between two locations. These locations partly serve also to divide the research into the basic and the fundamental areas. At the College Park location, both fundamental and applied research is conducted, while at the Salisbury station — in the heart of the broiler industry — only applied studies are conducted. The interested public is invited at all times to visit the research facilities, discuss projects and findings, and to suggest problems that they may feel need attention.

Applied Broiler Nutrition Studies

Practical broiler studies have been conducted to further refine the amino acid and protein requirements of male and female broilers, considering differences in ambient temperatures, energy level of the rations, and biological availability of the limiting amino acids (lysine and total sulfur amino acids). The results of four pen trials involving 32 pens of 150 broilers in each (total of 19,200 broilers) have supported previous estimates of the requirements for lysine and total sulfur amino acids for winter and summer feeding conditions.

Two trials were conducted involving males and females reared separately in which both starter broiler rations and finisher broiler rations were varied systematically in energy content from 1,400 to 1,475 calories metabolizable energy per pound of starter feed and from 1,425 to 1,500 calories metaboliz-



Fats of worms infesting chicken are measured under different diet conditions.

able energy per pound of finisher feed.

In both trials, broilers fed rations containing less than 1,425 calories of metabolizable energy per pound of

starter feed and 1,450 metabolizable calories per pound of finisher feed grew slightly less rapidly than broilers fed higher levels. However, there was no growth advantage over these levels when higher levels were used. The amount of feed required per unit gain was reduced proportionately as energy content was increased in these rations above that required for optimal growth.

The feed cost per pound of gain in weight was continuously increased up to 2.8% when the highest levels of energy were used during the starter and finisher periods. These results clearly show that the use of feeds containing higher levels of energy than needed to support optimal growth results in an increased feed cost with the price of feed ingredients as it existed during the past year.

In all these studies, the nutrient levels were related to energy content of the feed and total nutrient intakes per pound of broiler did not vary appreciably from one energy level feed to another after an adequate level was sup-

plied to support optional growth.

Considering that approximately 60 million dollars is spent annually for broiler feed in the Delmarva area, these results could potentially save the Delmarva area approximately 1.65 million dollars annually as many feed manufacturers are using energy levels in excess of those that are most economical for efficient broiler production.

In addition to these two trials, a broad study of the use of linear program broiler feed formulas has been conducted during the past year with the University of Maryland providing linear programming formulation service for several of the feed manufacturers in the Delmarva area. This study has included several conferences with the nutritionists in these groups to identify the way in which improved efficiency could be obtained through the use of rations formulated to be most economical.

As a part of this, data obtained from other research studies involving biolog-



Radioactive materials are used to study role of folic acid in formation of Coenzyme Q.

ical availability of lysine and methionine for several practical feed ingredients have been used. These ingredients include soybean meal, fish meal, poultry by-products meal, meat scraps, meat and bone scraps, corn gluten meal and corn. The formulas produced through this program have influenced the feeding practices for approximately 80 percent of all the broilers fed during the year in the Delmarva area, and have led to marked interest from other areas throughout the country.

Metabolic and Nutritional Studies on Microorganisms Important to the Poultry Industry

Heavy growth of *Mycoplasma gallisepticum* strain J (PPLO) can be obtained on a completely synthetic amino acid medium without serum or lipids being added, if the medium is supplemented with 300 micrograms per ml. of Trypticase (a casein digest). Ash of casein digests contributed to this improved growth; aluminum chloride in microgram quantities was partially effective in replacing the ash. A requirement for lipoic acid was demonstrated for two strains in lipoic-depleted cultures.

Studies on *Tetrahymena pyriformis*, a free living protozoa, showed that light inhibited growth and lipid synthesis

It is believed that the Maryland linear program for computing broiler feeds and other poultry feeds is the most advanced one in use at the present time. It takes into account approximately 69 restrictions in routine formulation, and has consistently resulted in lower cost rations which perform equal or better than those formulated with less thorough consideration of the many factors to be considered in the economic formulation of efficient feeds.

Project M-66

was changed in that the content of δ — linolenate and other unsaturated fatty acids were increased. An unidentified, unsaturated fatty acid in the phospholipid fraction was noted. In an iron-deficient medium, such as Proteose-peptone, *Tetrahymena* synthesized a visible amount of protoporphyrin IX in the dark. Addition of iron resulted in heavier cultures both in the light and in the dark, and protoporphyrin synthesis was not evident in these dark-grown cultures.

Studies on the lipid content of helminths in chickens are continuing.

Project M-58

The Effect of Processing on the Availability of Energy and Amino Acids in Wheat and Its By-products

Raw wheat germ, a highly valuable nutritional ingredient, has been found to contain a factor which causes enlargement of the pancreas, blocks fat absorption, and is deleterious to chick growth. A water soluble factor which agglutinates red blood cells has also been isolated. This is indicative of a

toxin.

All of these factors are destroyed by autoclaving (pressure cooking). This treatment should increase the value and usage of wheat germ meal in animal feeds.

Project M-67

Use of Chick Bio-Assay in Measuring Specific Amino Acid Availability

The total amino acid values as determined by a method such as column chromatography are only a measure of the "potential" value and do not indicate the amounts that are "available." Little is known about the variations in the availability of individual amino acids in proteins. Generally, lysine and methionine are the two amino acids most likely to be critical in practical diets.

A chick bio-assay has been developed for determining the available

methionine and lysine content of feed-stuffs. Soybean meal (50% protein), corn gluten meal (60% protein), yellow corn, menhaden fish meal, poultry by-products meal and meat scraps have been assayed for these amino acids. Large differences between the available lysine content as measured by the chick bio-assay and the total amino acid level as determined by chemical analysis were observed in corn gluten meal.

Project M-208

Effect of Protein Level and Amino Acid Balance on Voluntary Food Consumption

Investigation of the effect of amino acid balance and protein level on voluntary food consumption has been continued. Adding excesses of certain amino acids to a well balanced chick diet caused a marked reduction in food intake after one hour of feeding. Blood analysis revealed that there is a sharp rise in the amino acid level of the blood of the amino acid fed in excessive amounts in the diet.

The accumulation of the high level of the amino acid in the blood ap-

pears to influence voluntary food intake. The exact mechanisms that control voluntary food intakes are still unknown.

When chicks are kept in a cold environment, their performance on a diet low in an essential amino acid improves. However, when a diet with an excess of certain of the essential amino acids is fed to birds in a cold environment, their feed consumption and growth rate decreases.

Project M-209

The Influence of Dietary Protein and Carbohydrate on Serum Proteins

The results of a series of studies indicate that when the protein level is reduced without changing the energy content of the diet, both the total serum protein and albumin levels are reduced. However, when the daily energy allowance is reduced without changing the

protein intake, there is a rise in both total serum protein and albumin levels. The results suggest that neither total serum protein nor albumin levels are sensitive measures of protein quality.

Project M-210

Determination of Amino Acid Requirements of Growing Broiler Chicks and Laying Hens

Studies with broiler chicks have been conducted to determine an "available" lysine requirement for chicks based on body composition. The requirement has been expressed as functions of growth rate and maintenance needs with body composition defined.

Studies with hens were performed to

determine the available lysine requirement of laying hens (milligrams of lysine per hen per day) expressed as a function of maintenance, change in body weight, and grams of eggs produced per day.

Project M-210

Red Blood Cell Transketolase Activity of Chickens as an Index of Thiamine Nutriture

The thiamine content of the ingredients used in practical poultry rations is usually high enough to supply all the bird requires. However, if an ingredient such as corn is stored for long periods of time, the thiamine content may drop and it is possible that the amount in the diet could become marginal. A biochemical index of thiamine adequacy could be very useful.

In a laying hen study, there was some reduction in red blood cell transketolase activity before egg production ceased on diets deficient in thiamine. It would appear, therefore, that red blood cell transketolase activity may be a sensitive index of thiamine nutriture in the laying hen. This is in keeping with the chick studies when the red blood cell transketolase activity was reduced with poor growth.

Project M-207



Measuring red blood cell transketolase, a thiamine-containing enzyme.

Genetic Adaptation for Broiler Breeding Stock

Broiler production is a major agricultural enterprise in Maryland yet the industry depends almost exclusively on the importation of its breeding stock. The primary breeders, for good economic reasons, have used most of their selection pressure to improve rate of growth and conformation and have not emphasized viability. The environmental conditions under which selection in the primary breeding stock is made are generally considerably superior to the environmental conditions under which the resulting broiler chicks are expected to grow.

This project is designed to see if breeding stock selected under adverse conditions as they exist in the commercial broiler-producing area would have better viability on the average commercial broiler farm than the currently available stocks. Since leucosis is one of the major disease hazards, con-

siderable emphasis will be placed on the resistance to this disease.

Foundation stock based on the currently used broiler strains has been secured. A total of three generations has been produced in which selection pressure was based primarily on viability and rate of growth. The stock so far has been grown at the College Park locations; however, new facilities are being developed at the Salisbury Substation and the program will be continued there. A total of 25 single male mating pens will be employed. To measure change in disease resistance, the birds each year will be compared with stock taken from the Georgia random-bred broiler stock. This stock is thought to be quite genetically stable. The performance of the stock will also be compared from time to time with commercially available strains.

Project M-68

Protein Adequacy on the Efficiency of Selection

This project originally was to employ turkeys as the experimental animal to determine whether or not strains selected on protein adequacy would be more apt to fatten readily when full-fed. Due to a curtailment of some of our physical facilities, it became necessary for us to discontinue all turkey work, and the fundamental aspects of the problem have been continued using the Coturnix quail as the experimental animal.

Two diets were employed; one a diet thought to be adequate in all known requirements; and the second a diet known to be deficient in lysine. The

rate of growth of the young quail on both of these diets was measured between the second and fourth weeks of age.

Eight generations of selection for rate of growth on these two diets have been completed. During the first four generations, there was little or no progress made in improving the growth rate in either line. Since that time, there has been a gradual increase in four-week body weight in both lines, and the rate of improvement has been slightly greater in the deficient lines. While there has been a slow, gradual increase in adult body weight in all

lines, there have been no perceptible changes in other traits such as hatchability, mortality, age of sexual maturity, egg weight, or egg color.

There are now a large number of individuals (34%) in the deficient line which equal or exceed the average four-week body weight of the full-fed line. This indicates that we are making slow but steady progress in selection of a line of quail which will grow well on a lysine-deficient diet.

Studies completed show that, to date, there is no difference between the lines in body fat content. Because this lack of a difference might be due to overconsumption of feed in either or both lines, feed consumption and conversion studies will be completed at an early date. In connection with these studies, all lines will be grown on all rations to assess the effect of ration (lysine content) on the various lines.

Project M-400

Relationship Between Cathepsin Level and Leucosis

The number one killer of poultry is a cancer-like disease called leucosis. Although this disease usually does not cause death until chickens are beyond broiler age, it has become a problem in broiler flocks as one of the major causes of condemnation during inspection in dressing plants. Certain evidence has been obtained indicating that genetic differences in susceptibility to leucosis may, at least in part, be related to the level of the enzyme cathepsin in blood serum.

An experiment to test this has been started in which genetic selection will be made to obtain lines with high and low levels of cathepsin in blood serum. The innate susceptibility or resistance of these lines to leucosis will provide a



Measuring water loss from dressed birds following different processing procedures.

critical test of the relationship of resistance to this disease and cathepsin level in blood.

Project M-303; NE-51

Influence of Processing on Quality Retention in Poultry Meats

Blood volume in live broilers was determined by using a sample iodine tracer that was injected into the blood.

As the blood circulates, the iodine becomes evenly distributed. A sampling of the blood to determine the amount

that the iodine has been diluted gives an accurate estimate of the amount of blood in the body. We found, as others have reported, that as the bird size increases blood volume increases. This would indicate that longer bleeding time is necessary for larger birds. The blood volume will vary from seven to 12 percent of the live body weight depending on size.

Various methods of slaughter were also tried. A stunned bird bled with a standard cut lost the most blood in a given time (90 seconds). Previous work by this station has shown the

amount of blood that remains in various parts of the carcass.

In a study of factors of egg quality, a specific protein was isolated which makes the egg white firm. The amount of this protein can be altered by diet. The components of this protein are now being studied.

Data were collected from a processor over a period of a year on 14 variables that might affect carcass quality. Preliminary studies indicated that many of the factors are correlated. A more detailed analysis is now being made.

Project M-100

Cause of Transport Bruising of Live Broilers and Possible Methods for Reduction

Bruising in broilers is the major cause for loss in quality as well as a loss in yield. In a recent survey, housewives indicated that they object seriously to buying bruised poultry. Bruising occurs in the broiler house, during catching and transport to the processing plant, during unloading, and it even may occur for a time after the bird is bled.

We have worked on methods of standardizing a bruise by varying the energy applied as well as the surface area striking the bird. The results were more repeatable when breast muscle was used. A high force and small surface area of the striking object caused the largest bruise. It was difficult to analyze differences between weight classes. Many other variables enter into the picture which complicate the pattern of bruises. At present, design experiments to control some of the variables are being conducted.



Facilities for housing the Coturnix quail, a small bird which weighs $\frac{1}{4}$ to $\frac{1}{3}$ pound and is a very useful research animal.

In addition, samples of birds raised over the past year at our substation have been collected. Bruises have been recorded and these data are now being analyzed.

This project will not solve the bruising problem. It will give basic infor-

mation on what factor could reduce the incidence and where to look for trouble. The problem of bruising will

be substantially reduced only when new methods of loading are devised.
Project M-61

Effects of Gonadal Hormones on Embryonic and Postnatal Bone Growth

In the domestic fowl, males are larger than females; in Japanese quail, the reverse is true. These two species thus make excellent research material for studying the basic genetic and/or physiological differences that control sexual dimorphism for body weight. Injections of male and female hormones, or combinations thereof, into these species have produced different results.

The combined hormones, injected

into the fowl, result in bone shortening without suppression of body weight in females. Injections of the same hormones into the quail produced only suppression of body weight in females with no change in bone growth. These results are puzzling, but at the same time interesting; further research is under way to further study the differences in response.

Project M-64



Aerial view of poultry research facilities at Salisbury, Maryland, where much of the applied practical research is conducted.

Lipid Metabolism of Fowl Spermatozoa

Analyses of chicken sperm lipids showed a high percent of phospholipids; 75 percent for the Flightless strain and 83 percent for the White Leghorn; the remaining were neutral lipids. Of the neutral lipids, about 65 percent is cholesterol or other sterols; therefore, about 11 percent of the total lipid is sterol. The rest of the neutral lipid fraction is composed of glycerides, free fatty acids and wax esters.

The wax esters of the sperm contain no cholesterol, hence they are not the type usually found in animal body fats. The fatty acids in the wax esters contain about 66 percent of monoenoic fatty acids of 16 to 20 carbons, and 33 percent saturated fatty acids of 16 and 18 carbon lengths. Similar fatty acids

were found in the other neutral lipid fractions. The total lack of polyunsaturated fatty acids in the neutral lipids contrasts markedly with the fairly high proportion (26 to 37%) of these acids in the phospholipid fractions.

Different strains of chickens have somewhat different phospholipid fatty acid content. Short term storage at 40° C. produced some changes in lipid composition, especially in the amount of wax esters, and in the neutral lipid fractions, where oleic acid content decreased and another unsaturated fatty acid (C. 22:4) appeared. Freezing of sperm did not influence the content of phospholipid polyunsaturated fatty acids.

Project M-59

VETERINARY SCIENCE

Livestock has been referred to as the foundation of the nation's agriculture. Diseases and parasites cause an annual loss of \$2.7 billion to the livestock industry in the United States. By developing research programs and applying control measures, veterinary science aims to minimize economic loss to the industry and assist in safeguarding human health. Currently, veterinary medicine is being integrated with human medicine to enhance control of zoonotic diseases that menace the health both of animals and man. Bovine mastitis continues to be a serious health problem. During the period from 1951 to 1960, losses caused by this malady alone were estimated at more than \$400 million. The poultry industry suffers from needless and preventable loss due to death of fowls, loss of meat and egg production and down-grading of carcasses in the slaughterhouse. Leptospirosis, once considered to be a relatively rare disease, is now known to be more widespread and often to be an inapparent infection both of man and animals. New knowledge is being brought forth concerning bovine shipping fever, and investigations of lymphosarcoma of cattle are revealing valuable information about this serious ailment. Research in medical science has brought relief from many ailments for which formerly no remedy was known. Other disease problems, however, remain unsolved and new maladies appear which require the best efforts of science.

Respiratory Diseases of Poultry

A study was made to determine the identity and frequency of a bacterial and several viral organisms in 222 selected cases of fowls affected with respiratory disease in the Delmarva area.

Newcastle disease virus (NDV) alone was isolated in 17 (7.6%) cases; NDV plus *Mycoplasma gallisepticum* (MG) was isolated in 3 (1.3%) cases; infectious bronchitis virus alone (IBV) was isolated in 61 (27.4%) cases; IBV plus MG was isolated in 25 (11.2%) cases; infectious laryngotracheitis virus alone (ILT) was isolated in 12 (6.7%) cases; ILT plus MG was isolated in 7 (3.1%) cases; MG alone was isolated in 25 (11.2%) cases; ILT plus IBV was isolated in 1 (0.4%) case; and 68 (30.6%) were negative to the above named organisms.

Serological differences between NDV isolates were not detected. In general, as compared with the record of previous years, an increase was noted in the number of outbreaks of respiratory dis-

ease in poultry. In studies on chronic respiratory disease (mycoplasmosis), the plate agglutination test was applied to a total of 116,107 chickens in 1,001 flocks and 587 turkeys in one flock.

Positive reactions were recorded in 45,142 (38.8%); suspicious reactions were recorded in 12,012 (10.3%); while 58,943 (50.1%) were classed as negative. Some difficulties were encountered in interpreting reactions of the plate test in field cases. Slaughterhouse condemnations due to "air-sac" infection in 397,300 broilers from four breeder flocks vaccinated with MG vaccine ranged from 0.02% to 7.7% per consignment.

One out of eight MG isolates from Tylan-treated flocks were found resistant to the drug. It was concluded that protection afforded by some modified ILT vaccines may be decreased when administered simultaneously with IB vaccine.

Project D-52 (NE-5)

Bovine Mastitis

The study on the *Pseudomonas aeruginosa* problem in a Maryland institutional herd has been completed with the elimination of *Pseudomonas aeruginosa* from the herd. Various techniques were used for diagnosis, treatment, and management in order to control this infection. The use of an autogenous bacterin, specific antibiotics, and special sanitation measures did not control or eliminate this infectious organism. The elimination of *Pseudomonas* from the herd was effected by culturing individual quarter samples on an aver-

age of 100 cows at bi-weekly intervals, accompanied by radical culling of all shedders of *Pseudomonas*.

Two surveys employing the Wisconsin Mastitis Test, a test for abnormal milk, have been completed. Maryland dairy farmers received these results in December 1966. This test is a screening procedure to determine the number of leukocytes in milk.

Bulk milk containing over 500,000 leukocytes per ml. is considered abnormal. The results of two rounds indicate that 65 percent of the dairy herds ship-

ping Grade A milk are below 500,000 leukocytes, 28 percent are between 500,000 and 1,000,000 leukocytes, and 7 percent are shipping milk with over 1,000,000 leukocytes.

The study of the epidemiology of hemolytic staphylococci with the use of bacteriophage typing is in progress.

Project D-58

Diagnosis of Infectious Coryza in Chickens

Immunofluorescent staining promises to lend itself to a rapid method for the diagnosis of many diseases caused by viruses and bacterial organisms. Particularly in the case of ailments caused by organisms not readily demonstrable by other methods, immunofluorescent staining may provide a means for early diagnosis and application of specific therapeutic measures.

Infectious coryza is one of the five rather common respiratory diseases of poultry. It is caused by the bacterial organism, *Hemophilus gallinarum*. These organisms, however, usually are mixed with other bacterial species in the nose and throat of the diseased fowl. Unless properly stained, they are not readily distinguished in smears prepared for examination under the microscope and sometimes are not easily isolated by culture.

Immunofluorescent stains are prepared by chemically combining immunoglobulin from blood serum with a fluorescent dye. Such stains are highly selective in action because immunoglobulin will combine only with the

organism that produced it. Fluorescing dye conjugated with the globulin renders the organism visible when activated by ultraviolet light.

In the current investigation, immunoglobulin is produced in rabbits by intraperitoneal injection with cultures of *Hemophilus gallinarum*. The globulin fraction of immune serum then is conjugated with fluorescent isothiocyanate. After inoculating a group of experimental chickens with *H. gallinarum*, individual birds selected at random are sacrificed at progressive intervals; postinoculation and immunofluorescent staining is employed to examine various tissues of the body for the presence of the causative organism.

By this method, more information can be gotten concerning distribution of the organism in the body of the fowl and the presence of *H. gallinarum* in tissues of certain carrier birds. In addition, the relative efficiency of diagnosis by culture and immunofluorescent staining is to be determined.

Project D-59

Leptospirosis

Experiments on the effect of exposure and re-exposure of calves and hamsters to *Leptospira canicola* and *L. pomona* were completed.

In general, it was observed that calves, upon initial exposure, reacted with elevated temperatures, leptospiemia and hematologic changes. Upon

re-exposure, these signs were not as severe, and, in some instances, absent. Immunologic response was good and persisted after the second exposure.

With hamsters, initial exposure caused death and severe pathologic changes in the liver, lungs and kidneys.

Survivors were re-exposed. There was an abatement in signs and when death occurred, it was after a prolonged time. Thus, it was concluded that cross-infections will give cross-protection, at least to some degree.

Project D-62 (NE-40)

Bovine Respiratory Diseases

During the year, several suspected outbreaks of shipping fever (SF) and infections bovine rhinotracheitis (IBR) in Maryland cattle were studied.

The findings of these studies indicate that IBR and SF viruses have been prevalent in Maryland during the past year. The DNA analog, 5-Iodo-2'-deoxy-uridine (IUDR) inhibited the growth of IBR virus in bovine embryonic kidney cell cultures. The virus was sensitive to this drug at 10^{-4} M and abnormal viral DNA was produced in

its presence.

The drug sensitive reaction appeared five hours after infection, preceding the earliest appearance of progeny virus by three hours. When added up to six hours after exposure of infected cells to IUDR, thymidine restored virus productivity; thereafter, the cells progressively lost their capacity to produce infectious virus. A bovine adenovirus failed to produce tumors in newborn and weanling hamsters after one year.

Project D-63

The Propagation of Infectious Laryngotracheitis Virus of Chickens in Chicken-Kidney Cell Culture

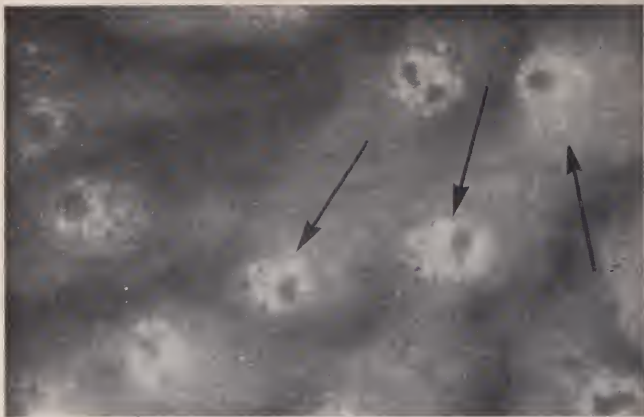
Propagation of infectious laryngotracheitis (ILT) virus in cell culture has some advantages over the older method of propagation in chicken embryos. The virus is suspended in a less complicated medium and its intracellular development can be more readily studied.

Viral replication in the cell culture starts within the nucleus. After 42 to 48 hours, the cell membrane ruptures and virus is released into the culture fluid. Other cells then take up virus and a second cycle of viral replication begins. When cell cultures are harvested, therefore, some virus is present

in the culture fluid and some is present in the cells. In order to make available the total amount of virus in the culture, it is necessary to free virus from the culture cells.

One method of accomplishing this release is to alternately freeze and thaw the culture, thus rupturing the cell wall. It was determined that four cycles of the alternate freeze-thaw process within a six-hour period can be carried out without harm to the virus. Additional freezing and thawing over a longer period of time causes ILT virus to deteriorate.

In other studies, it has been shown



Photomicrograph of chicken-kidney cell culture showing (arrows) immunofluorescent staining of developing infectious laryngotracheitis virus (X1090).

that kidney cell cultures must be allowed to adsorb virus for three hours before starting to calculate the time required for virus replication. In attempting to extend the adsorption period, it was found that virus begins to deteriorate soon after a three-hour period at 25°C and that by 12½ hours as much as 90 percent of the virus is lost.

The titer of the Kerchock strain of ILT virus in chicken-kidney cell culture can be increased 21½ fold if inoculated cultures are allowed to stand at 25°C for 10 to 22 hours before being incubated at the usual temperature of 37°C. Colchine, which inhibits mitotic cell division in the late metaphase by interfering with deoxyribonucleic acid (DNA) reduces the titer of ILT virus

10-fold when added to cell culture 12 hours postinoculation in a concentration of 0.03 mg/ml.

While replication of ILT virus in monolayer chicken-kidney cell cultures is conveniently employed for various purposes, volume production of virus could be better accomplished in a larger quantity of cells grown in suspension.

Accordingly, the rate of cell multiplication in Eagles Balanced Medium was determined by counting, in a hemocytometer, the number of cells produced after progressively longer periods of incubation. It was thus determined that cell multiplication reached its maximum 24 hours postinoculation and declined rapidly thereafter.

Project D-64

Etiology, Pathogenesis, Laboratory Diagnosis, and Chemotherapy of Bovine Lymphosarcoma

During 1965-1966, which was the fourth year of experimentation on the twelve calves originally administered bovine lymphosarcoma (BLS) material, two calves, one of those injected with tissue culture (TC) and one of those given sonicated extracts (SE) orally, maintained steady, strong, positive, reactions with an average for the year of $10,500 \pm 311$ and $14,083 \pm 593$ circulating lymphoid cells (CLC/cmm, respectively).

Four others developed a steady suspicious reaction. These were: one of those injected with emulsion, two of those injected with SE, and the other injected with TC. Of these four animals, the one injected with emulsion had a blood reaction which ranged from normal to suspicious during the preceding three years, whereas the other three had developed positive to suspicious reactions during that time. Clinically, no signs related to leukemia have been observed to date.

Among the originally inoculated animals, one bull (#2), which had been injected in the thymus area with emulsion of BLS masses within fifteen minutes after the removal of these masses by biopsy, showed a tremendous hyperplasia of the prescapular and sternal lymph nodes, which microscopically had some characteristics of neoplasia.

The prescapular lymph nodes weighed: left 242 grams, right 250 grams. Microscopically, however, the changes of these lymph nodes were found to be a chronic immunological response, probably a result of the in-

oculated material and the microtraumas of the feet, related to chronic carpalitis and bone deformations resulting from a congenital chondroosteodystrophy of which the inoculated calf was suffering.

Further experimentation was carried out with inoculations of eight newborn calves. Three of these were inoculated with plasma isolates obtained from two calves previously inoculated with BLS, four with SE of lymph nodes obtained by biopsy from animals also previously inoculated, and one with homogenates obtained from murine lymphosarcomatous masses as mentioned below. Two of the calves inoculated with SE of bovine lymph nodes were injected subcutaneously shortly after birth with ethyl carbamate (Urethan), a chemical compound known to be leukemogenic to mice.

In experimentation with newborn mice, a very potent virus-like agent was isolated after the 18th passage of SE or the original BLS material. This agent produces lymphoblastic leukemia 100 percent in newborn mice within three to four weeks after inoculation. In dilutions 10^{-6} , it is still leukemogenic. In seroneutralization tests in mice, this agent appeared to be different from the Rauscher's murine leukemia virus.

Identification and characterization of this agent will require further studies including various laboratory tests, electromicroscopy, and inoculations in several newborn calves in order to demonstrate its biological effect, if any, in the bovine species.

Project D-65

Toxic Substances Produced by Molds

Six toxic substances have been isolated from extracts of the mold *Stachybotrys atra*. Techniques have been developed for the detection and isolation in quantities which it is hoped

will be sufficient for chemical identification. The study is being continued to further characterize the unknown substances.

Project D-66

STATION STAFF

1965-1966

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FINANCIAL STATEMENT -- JULY 1, 1965 TO JUNE 30, 1966

	<i>Federal Funds</i>		
	<i>Hatch Amended</i>	<i>Regional Research</i>	<i>Forestry McIntire-Stennis</i>
<i>Appropriations 1965-1966</i>	\$513,737.00	\$163,161.00	\$34,974.00
TOTALS	513,737.00	163,161.00	34,974.00

Receipts from sources other than Federal 1965-1966

State Appropriations for Agricultural Investigations	\$1,551,704.33
Special Endowments, Fellowships and Grants	42,922.00
Sales & Miscellaneous	208,874.12
Total.....	\$1,803,500.45

Balance brought forward July 1, 1965

TOTAL

Expenditures:

Personal Services	\$407,163.59	\$ 75,220.08	\$30,244.39
Travel & Transportation	1,151.86	3,851.25	1,654.44
Equipment	53,215.58	47,386.47	3,132.23
Lands & Structures	11,398.00	-----	-----
Supplies & Materials	28,063.89	22,617.70	1,141.74
All Other	12,744.08	14,085.50	1,437.62
TOTAL	\$513,737.00	\$163,161.00	\$37,610.42
Balance on June 30, 1966			7,398.14
TOTALS	\$513,737.00	\$163,161.00	\$45,008.56**

*Including Offset Funds

***Includes \$10,034.56 Holdover funds,

PUBLICATIONS

1965-1966

Technical Bulletins

- A136 Fat Excretion of College Women on Diets Containing Different Levels of Fat. Pela Braucher and Genevieve Watkins. 28 pp. June, 1964.
- A140 Respiratory Metabolism of Germinating Conidia of *Curvularia geniculata*. W. W. Townsley and A. A. Bell. 20 pp. May 1965.
- A141 Research Broadens Vision of Maryland Agriculture. (77th Annual Report of the Maryland Agricultural Experiment Station.) I. C. Haut, 118 pp. December 1965.
- A142 Relationships Between Linear Body Measurements of Live Beef Steers with Weights of Carcass Cuts and Rib-eye Area. John Buric. 19 pp. August 1966.
- A143 Pneumatic Handling of Chopped Alfalfa Hay. W. L. Harris, K. E. Felton, G. F. Burkhardt and N. E. Collins. 36 pp. May 1966.
- A144 A Comparison of Nitrogen Fertilized Grasses with a Grass-Legume Mixture as Pasture for Dairy Cows. J. E. Leslie, R. W. Hemken and N. A. Clark. 20 pp. May 1966.
- A145 In Review: Research in Maryland Agriculture. (78th Annual Report of the Maryland Agricultural Experiment Station.) I. C. Haut. 117 pp. November 1966.

Regular Bulletins

- 476 Selected Socio-economic Factors Influence on Red Meat Consumption in the Baltimore-Washington Metropolitan Area. Russell F. McDonald and Tridib K. Mukherjee. 35 pp. April 1966.
- 477 Influence of Selected Socio-economic Factors on Red Meat Consumption Patterns in the Northeast Region. R. F. McDonald. 21 pp. June 1966.

DEPARTMENT OF AGRICULTURAL ECONOMICS

Scientific Article

- A1273 Analyzing Systems of Agricultural Resource Organization. P. W. Foster. Jour. Farm Econ. 48(2):272-278. May, 1966.

Miscellaneous Publications

- 544 Economies of Large Size in the Production of Fluid Milk on Specialized Dairy Farms in Maryland. J. W. Wysong. Multilithed Circular. 52 pp. March, 1965.
- 552 Post World War II Foreign Trade in Maryland Tobacco. G. M. Beal and C. W. Coale, Jr. Multilithed Circular. 84 pp. December, 1965.
- 553 Improving Farm Land Tax Assessments in Maryland Under Non-Farm Use Pressures. W. P. Walker. Multilithed Circular. 38 pp. June, 1965.
- 555 An Analysis of Structural Changes in the Maryland-Delaware Fruit and Vegetable Processing Industry, 1950-1962. J. L. Cain and Mary E. Hutchison. Multilithed Circular. 26 pp. October, 1965.
- 557 The Transfer of Farm and Open Country Real Estate in Six Maryland Counties, 1962. R. A. Murray and R. D. Reinsel. Multilithed Circular. 64 pp. June, 1965.
- 570 Foreign Donations of American Abundance by Voluntary Agencies, 1950-64. P. W. Foster and J. E. Hutchison. Multilithed Circular. 24 pp. June, 1966.
- 571 A Review of Freight Rate Proposals Affecting the Maryland Poultry Industry. H. D. Smith and Earl Miller. Multilithed Circular. 39 pp. July, 1966.
- 582 The Economies of Dry-Lot Dairy Farms in Maryland. J. W. Wysong. Multilithed Circular. 59 pp. January, 1967.
- 584 An Economic Feasibility Study of Shooting Preserves in Maryland. R. W. Schermerhorn and W. K. Starkey. Multilithed Circular. 34 pp. July, 1966.
- 588 Allotment Distribution and Major Inputs Used in Producing Maryland Tobacco. J. Paxton Marshall and Billy V. Lessley. Multilithed Circular. 28 pp. June, 1966.

DEPARTMENT OF AGRICULTURAL AND EXTENSION EDUCATION

Miscellaneous Publications

- 539 Student Success in the College of Agriculture. C. R. Smith. Multilithed Circular. 68 pp. Sept., 1965.
- 559 Undergraduate Academic Achievement and Teaching Performance. V. R. Cardozier. Multilithed Circular. 76 pp. September, 1965.
- 586 Integrating Reading Instruction into Vocational Agriculture Classes. Dorothy D. Sullivan and V. R. Cardozier. Multilithed Circular. 18 pp. September, 1966.
- 589 Factors Associated with the Ownership of Rural Property for Recreational Purposes by Part-time Residents in an Appalachian County. I. R. Jahns and N. G. Smith. Multilithed Circular. 28 pp. March, 1967.

DEPARTMENT OF AGRICULTURAL ENGINEERING

Scientific Articles

- A1127 Design Data for Pneumatic Conveying of Chopped Forage. W. L. Harris, K. E. Felton and G. J. Burkhardt. Trans. ASAE 8(2):194-195, 198. 1965.
- A1133 The Performance of a Pneumatic System Conveying Chopped Forage. N. E. Collins, W. L. Harris and G. J. Burkhardt. Trans. ASAE 8(2): 196-198. 1965.
- A1227 Humidity Requirements for Best Broiler Performance. P. N. Winn, Jr. Proc. 1965 Broiler Housing Seminar Published by University of Delaware Substation, Georgetown, Del. Oct. 6, 1965. Pp. 25-28.
- A1253 Engineering Aspects of Application of Heat for Control of Alfalfa Weevil. W. L. Harris, C. C. Blickenstaff, A. L. Steinhauer and N. A. Clark. Proc. Third Annual Symposium on Thermal Agriculture Jan. 18, 19, 1966. Pp. 21-25.

Miscellaneous Publications

- 573 Sweet Potato Storage. G. J. Burkhardt. Proc. Penin. Hort. Soc. Pp. 17-19. 1965.
- 574 Sweet Potato Harvester Developments. G. J. Burkhardt. Proc. Penin. Hort. Soc. Pp. 13-16. 1965.

DEPARTMENT OF AGRONOMY

Scientific Articles

- A1141 Nutrient Balance in Midland Bermudagrass as Affected by Differential Nitrogen and Potassium Fertilization: Forage Yields and Persistence. C. B. Kresge and A. M. Decker. Proc. Ninth Internatl. Grassland Congress. Sao Paulo, Brazil. Jan. 7-20, 1965. Pp. 671-674.
- A1185 Sod-Seeding of Annual Forages Into "Midland" Bermudagrass (*Cynodon dactylon* L.) Pastures. I. Species Evaluation. F. G. Swain, A. M. Decker and H. J. Retzer. Agron. Jour. 57:596-598. 1965.
- A1186 Effect of Plant Density and Moisture Supply on the Quality of Sudangrass Forage. H. R. Koller and N. A. Clark. Agron. Jour. 57:591-593. 1965.
- A1189 Herbicide Metabolism: N-glycoside of Amiben Isolated from Soybean Plants. S. R. Colby. Sci. 150(3696):619-620. October 29, 1965.
- A1196 Effect of Soil Actinimycetes on Strains of *Rhizobium japonicum*. S. M. Dammirgi and H. W. Johnson. Agron. Jour. 58:223-224. Mar.-Apr. 1966.

- A1206 Yields, Stand Persistence, and Carbohydrate Reserves of Perennial Grasses as Influenced by Spring Harvest Stage, Stubble Height, and Nitrogen Fertilization. J. T. Raese and A. M. Decker. *Agron. Jour.* 58(3):322-326. May-June, 1966.
- A1215 The Mechanism of Selectivity of Amiben. S. R. Colby. *Weeds* 14(3):197-201. July, 1966.
- A1224 A Comparison of Nitrogen Fertilized Grasses with a Grass-Legume Mixture as Pasture for Dairy Cows. 1. Dry Matter Production, Carrying Capacity, and Milk Production. N. A. Clark, J. I. Leslie and R. W. Hemken. *Agron. Jour.* 58(3):280-282. May-June, 1966.
- A1238 Factors Affecting the Selectivity of Amiben on Soybeans. S. R. Colby. *Proc. N. E. Weed Control Conf.* 20:337-344. January, 1966.
- A1242 Atrazine-prometryne Combinations: Herbicidal Activity, Fate in Corn and Soil Persistence. S. R. Colby and C. I. Harris. *Proc. Northeast Weed Control Conf.* 20:115-121. January, 1966.
- A1243 Fate of the Amide and Methyl ester of Amiben in Soybean Plants and Soil. S. R. Colby. *Proc. Northeast Weed Control Conf.* 20:619-626. January, 1966.
- A1244 Control of Crabgrass, Goosegrass and Annual Bluegrass with Preemergence Herbicides. E. E. Deal. *Northeastern Weed Control Conf. Proc.* 20:537-546. January 5, 6, 7, 1966.
- A1271 Calculating Synergistic and Antagonistic Responses of Herbicide Combinations. S. R. Colby. *Weeds* 15(1):20-22. January, 1967.

DEPARTMENT OF BOTANY

Scientific Articles

- A1129 Van Slyke's Buffer Values for Cell Secretions. Constantine Sorokin. *Protoplasma* 60:79-85. 1965.
- A1153 Sterols of *Chlorella*. 1. The Naturally Occurring Sterols of *Chlorella vulgaris*, *C. ellipsoidea* and *C. saccharophila*. Glenn W. Patterson and R. W. Krauss. *Plant and Cell Physiol.* 6:211-220. June, 1965.
- A1156 Site of Action of Cycloheximide in Cells of *Saccharomyces pastorianus*. III. Further Studies on the Mechanism of Action and the Mechanism of Resistance in *Saccharomyces* Species. M. R. Siegel and H. D. Sisler. *Biochemica et Biophysica Acta* 103:558-567. 1965.
- A1171 The Usefulness of Tetrachloroisophthalonitrile and Tetrachloronitroanisole for Control of Helminthosporium and Rust Diseases of Kentucky Bluegrass. A. A. Bell and R. R. Muse. *Plant Dis. Reporter* 49(4):323-326. April, 1965.
- A1174 The Nonessentiality of Boron for *Chlorella*. J. E. Bowen, H. G. Gauch, R. W. Krauss, and R. A. Galloway. *Jour. Phycolgy* 1:151-154. 1965.
- A1177 Responses of Heterotrophic Cultures of *Chlorella vulgaris* Beyerinck to Darkness and Light. II. Action Spectrum for and Mechanism of the Light Requirement for Heterotrophic Growth. E. P. Karlander and R. W. Krauss. *Plant Physiol.* 41:7-14. January, 1966.
- A1178 Responses of Heterotrophic, Cultures of *Chlorella vulgaris* Beyerinck to Darkness and Light. I. Pigment and pH Changes. E. P. Karlander and R. W. Krauss. *Plant Physiol.* 41:1-6. January, 1966.
- A1194 Analyses of Total Lipids and Fatty Acids of Plant-Parasitic Nematodes and Host Tissues. L. R. Krusberg. *Comp. Biochem. Physiol.* 21:83-90. 1967.
- A1204 The Nonessentiality of Boron in Fungi and the Nature of Its Toxicity. J. E. Bowen and H. G. Gauch. *Plant Physiol.* 41(2):319-325. 1966.
- A1214 Incidence of Hypocotyl Collar Rot of *Phaseolus vulgaris* in the Field and in Germination Tests. F. J. Williams and M. H. Day. *Phytopath.* 56(5): 531-535. May, 1966.
- A1218 Monosomics in Maize Following X-irradiation of the Pollen. R. L. Baker and D. T. Morgan, Jr. *Cytologia - Internatl. Jour. Cytology* 31:172-175. 1966.

- A1221 The Mineral Composition of *Myriophyllum spicatum* L. in Relation to Its Aquatic Environment. R. R. Anderson, R. G. Brown, and R. D. Rappleye. Jour. Ecol. 47(5):844-846. 1966.
- A1231 Relationship of Structure to Fungitoxicity of Cycloheximide and Related Glutarimide Derivatives. M. R. Siegel and H. D. Sisler. Biochemical Pharmacol. 15:1213-1223. 1966.
- A1237 The Secretory Activity of Algal Cells in Buffered Media. Constantine Sorokin and Larissa Mitrofanov. Protoplasma 62(2-3):201-209. 1966.
- A1254 The Inhibitory Effect of Light on Growth of *Prototheca zopfii* Kruger. Bernard Epel and R. W. Krauss. Biochimica et Biophysica Acta 120:73-83. 1966.
- A1255 Mechanism of Action of Phytoactin in *Saccharomyces pastorianus*. J. P. Lynch and H. D. Sisler. Phytopath. 57(4):367-373. April, 1967.
- A1274 Partial Purification and Properties of RNA Polymerase from Maize. E. R. Stout and R. J. Mans. Biochimica et Biophysica Acta 134:327-336. 1967.
- A1278 The Function of the Endodermis in Resistance of Virginia Pine Seedlings to Damping-Off. W. K. Hock and W. L. Klarman. Forest Sci. 13(1):108-112. March, 1967.

DEPARTMENT OF DAIRY SCIENCE

Scientific Articles

- A1124 Comparative Study of the Monocarbonyl Compounds Formed During Deep Frying in Different Fats. L. A. Wishner and Mark Keeney. Jour. Amer. Oil Chem. Soc. 42(9):776-778. September, 1965.
- A1169 Depletion of Calcium, Magnesium, Strontium and Phosphorus by Hemodialysis from Ruminants. W. E. Stewart, R. F. Davis, and R. G. Cragle. Ninth International Grassland Congress, Sao Paulo, Brazil. Pp. 723-727. Jan., 1965.
- A1176 Identification of Steroids in Bovine Tissue Using Thin-Layer and Gas Chromatographic Techniques. W. F. Williams, J. Lynch, B. Fagan, and M. Barens. Jour. Dairy Sci. 49(1):100-102. January, 1966.
- A1187 Effect of Feeding Buffers to Dairy Cows Grazing Pearl Millet or Sudangrass. R. W. Miller, R. W. Hemken, J. H. Vandersall, D. R. Waldo, M. Okamoto, and L. A. Moore. Jour. Dairy Sci. 48(10):1319-1323. October, 1965.
- A1188 The Distribution, Movement and Persistence of Heptachlor and Its Epoxide in Alfalfa Plants and Soil. R. L. King, N. A. Clark, and R. W. Hemken. Jour. Agril. & Food Chem. 14:62-65. Jan.-Feb., 1966.
- A1190 Effect of Feeding Buffers to Dairy Cows Fed a High-Concentrate, Low-Roughage Ration. R. W. Miller, R. W. Hemken, D. R. Waldo, M. Okamoto, and L. A. Moore. Jour. Dairy Sci. 48(11):1455-1458. November, 1965.
- A1192 Electronic Dron Counter. C. R. Whitted, R. J. McCormick, and W. E. Stewart. Jour. Dairy Sci. 48(11):1538-1540. Nov., 1965.
- A1195 The Quantitative Micro Determination and Isolation of Plasmalogen Aldehydes as a 2,4-Dinitrophenylhydrazones. Ira Katz and Mark Kenney. Jour. Lipid Res. 7:170-174. January, 1966.
- A1210 Depletion of Calcium, Phosphate, and Strontium from Anesthetized Calves by Hemodialysis. H. F. Downey, W. E. Stewart, and R. G. Cragle. Jour. Dairy Sci. 49(6):668-673. June, 1966.
- A1235 Effects of Parathyroid Extracts on Depletion of Sr^{80} , Ca^{45} , and P^{32} by Hemodialysis from Conscious Calves. S. C. Perry, R. G. Cragle, H. F. Downey, W. E. Stewart, and C. E. Short. Jour. Dairy Sci. 49(6):674-679. June, 1966.
- A1236 Lactogenic Hormone Effects on Plasma NEFA and Blood Glucose Concentrations. W. F. Williams, A. G. Weisshaar, and G. E. Lauterbach. Jour. Dairy Sci. 49(1):106-107. January, 1966.

- A1268 Pancreatic Secretion in the Bovine Calf. R. J. McCormick and W. E. Stewart. Jour. Dairy Sci. 59(4):568-571. April, 1967.
- A1269 Occurrence of Ketostearic Acids in Rumen. Ira Katz and Mark Keeney. Jour. Dairy Sci. 49(8):967-970. August, 1966.
- A1270 Characterization of the Octadecenoic Acids in Rumen Digesta and Rumen Bacteria. Ira Katz and Mark Keeney. Jour. Dairy Sci. 49(8):962-966. August, 1966.
- A1272 Forestomach Bypass Surgery Procedure. W. E. Stewart, G. C. Henning, and J. H. Nicolai, Jr. Jour. Dairy Sci. 49(12):1543-1547.
- A1286 The Feasibility of an All Silage Forage Program. R. W. Hemken and J. H. Vandersall. Jour. Dairy Sci. 50(3):417-422. March, 1967.

DEPARTMENT OF ENTOMOLOGY

Scientific Articles

- A1111 Methods for Dissecting Mosquitoes. J. C. Jones. Mosquito News 27(1):76-82. March, 1967.
- A1149 An Analytical Study of Coitus in *Aedes aegypti*. J. C. Jones and R. E. Wheeler. Jour. Morphol. 117:401-424. 1965.
- A1154 *Aedes aegypti* with Four Spermathecae. J. C. Jones and K. W. Ludlam. Mosquito News 25(1): 1 page. March, 1965.
- A1173 The Hemocytes of *Rhodnius prolixus* Stal. J. C. Jones. Biol. Bul. 129(2): 282-294. 1965.
- A1180 Studies on Spermathecal Filler in *Aedes aegypti* (Linnaeus). R. E. Wheeler and J. C. Jones. I. Description. Biol. Bul. 129(1):134-150. 1965. II. Experimental. Biol. Bul. 129(3):532-545. 1965.
- A1193 An Improved Method for Storage of the Alfalfa Weevil in the Laboratory. H. Desmond Byrne. Jour. Econ. Entomol. 58(6):1161. December, 1965.
- A1199 Green Peach Aphid Control on Tobacco with Systemic Insecticide. F. P. Harrison and A. W. Woolridge. Jour. Econ. Entomol. 59(2):270-272. April, 1966.
- A1201 Studies on Spermathecal Filling in *Aedes aegypti* (L.). II. Experimental. J. C. Jones and R. E. Wheeler. Biol. Bulletin 129(3):532-545. December, 1965.
- A1205 The Attraction of the Alfalfa Weevil, *Hypera postica* (Coleoptera: Curculionidae) to Alfalfa. H. D. Byrne and A. L. Steinhauer. Annals of Entomol. Soc. America 59(2):303-309. March, 1966.
- A1207 Mechanisms of Contamination of Alfalfa with Heptachlor and Heptachlor Epoxide. H. D. Byrne and A. L. Steinhauer. Jour. Econ. Entomol. 59(2):338-341. April, 1966.
- A1213 New Host Record for *Phytomyza illicicola* and an Associated Wing Vein Abnormality. L. A. Kulp. Annals of Entomol. Soc. America 59(3):614. May, 1966.
- A1220 Dimethoate Residues in Leafy Crops. Katherine A. Nelson, R. E. Menzer and L. P. Ditman. Jour. Econ. Entomol. 59(2):404-406. April, 1966.
- A1225 The Effect of Temperature on Fecundity and Longevity of the Black Blow Fly, *Phormia regina*. D. W. Parrish and W. E. Bickley. Jour. Econ. Entomol. 59(4):804-808. August, 1966.
- A1240 Hatching of the Eggs of *Aedes taeniorhynchus* (Wiedemann) (Diptera: Culicidae) in Response to Temperature and Flooding. R. C. Moore and W. E. Bickley. Mosquito News 26(3):405-415. September, 1966.
- A1241 Attractiveness of Alfalfa Extracts to the Alfalfa Weevil, *Hypera postica*, in Relations to Water. H. Desmond Byrne, A. L. Steinhauer and R. E. Menzer. Annals of Entomol. Soc. of America 59(5):1013-1014. September, 1966.

- A1247 Effect of Spray Volume and Pressure on the Control of Larvae of the Alfalfa Weevil, *Hypera postica* (Gyll.), with Conventional Spray Equipment. A. L. Steinhauer, C. C. Blickenstaff and V. E. Adler. Jour. Econ. Entomol. 59(4): 1012. August, 1966.
- A1249 Field Studies on Flaming for Control of Alfalfa Weevil in Maryland, 1965. A. L. Steinhauer, C. C. Blickenstaff, W. L. Harris and N. A. Clark. Third Annual Symposium on Therma Agr. pp. 44-47. Jan. 18-19, 1966.
- Miscellaneous Publications**
- 511 DDVP as a Mosquito Adulticide. W. T. Garrett. Proc. N. J. Mosquito Exterm. Assoc. pp. 111-113. March 10-12, 1964.
- 533 Control of Apple and Peach Pests with Dilute and Concentrate Sprays. E. R. Krestensen and Castillo Graham. Trans. Penin. Hort. Soc. 54(5):36-42. 1964.
- 561 Control of Orchard Mites with Dilute and Concentrate Sprays. Castillo Graham and E. R. Krestensen. Trans. Penin. Hort. Soc. 55(5):75-82. 1965.
- 566 Quantitative Studies on the Hemocytes of *Rhodnius prolixus* Stal (Hemiptera). J. C. Jones. Proc. XII Internatl. Congress Entomol. Page 225. 1964.
- 567 Control of Apple and Peach Pests with 6X, 10X and 33X Concentrations. E. R. Krestensen and Castillo Graham. Proc. N. Y. State Hort. Soc. 111: 135-137. 1966.
- 568 Adaption of Equipment for Concentrate Spray Applications. E. R. Krestensen and Castillo Graham. Mountaineer Grower 262: 38-39. 1966.
- 572 Control of Peach and Apple Pests with Concentrate Sprays. Castillo Graham and E. R. Krestensen. Jour. Natl. Peach Council 25:116-119. 1966.
- 535 A Current Look at Pest and Disease Control of Outdoor Roses. S. W. Jacklin, W. L. Klarman and F. F. Smith. Amer. Rose Annual 51:68-72. 1966.
- 538 Md. 59 and Md. 609, Two New Tobacco Varieties Resistant to Black Shank for Maryland Production. O. D. Morgan. Multilithed Circular. 11 pp. April, 1965.
- 540 Effect of Fungicidal Sprays on Disease Control and Yield of Cantaloupes and Tomatoes on the Eastern Shore of Maryland, 1964. J. G. Kantzes and L. O. Weaver. 54(5):14-17. 1964.
- 541 The Effect of Trizone Fumigation with and without Plastic Covers on Yield of Vegetable Crops. J. G. Kantzes. Trans. Penin. Hort. Soc. 54(5):7-9. 1964.
- 556 Checklist of Vascular Aquatic Plants on the Upper Patuxent Estuary. Richard Anderson, Charles Philipp, R. D. Rappleye and R. G. Brown. Mimeographed Circular 13 pp. July, 1965.
- 577 Effect of Fungicidal Sprays on Disease Control and Yield of Cantaloupes and Cucumbers on the Eastern Shore of Maryland, 1965. J. G. Kantzes. Seventy-ninth Trans. Penin. Hort. Soc. 55(5):32-36. 1965.
- 578 Effect of Fungicidal Sprays on Disease Control and Yield of Tomatoes on the Eastern Shore of Maryland, 1965. Seventy-ninth Trans. Penin. Hort. Soc. 55(5):45-46. 1965.
- 579 The Effect of Trizone Fumigation on Yield of Cantaloupes and Tomatoes. J. G. Kantzes. Seventy-ninth Trans. Penin. Hort. Soc. 55(5):27-31. 1965.

DEPARTMENT OF FOODS AND NUTRITION

(COLLEGE OF HOME ECONOMICS)

Scientific Articles

- A1197 Fertilization Effects on the Chlorophylls Carotene, pH, Total Acidity and Ascorbic Acid in Broccoli. Mary S. Eheart. Jour. Agr. & Food Chem. 14(1):18. Jan.-Feb., 1966.
- A1280 Effect of Microwave- Vs. Water-Blanching on Nutrients in Broccoli. Mary S. Eheart. J. Amer. Dietetic Assoc. 50(3):207-211. March, 1967.

DEPARTMENT OF HORTICULTURE

Scientific Articles

- A1136 Measuring and Recording Rheological Properties of Gels. Amihud Kramer and J. V. Hawbecker. Food Tech. 20(2):111-115. February, 1966.
- A1140 Physical Methods of Measuring Quality of Canned Peas. S. Angel, Amihud Kramer and S. N. Yeatman. Food Tech. 19(8):96-98. August, 1965.
- A1167 Qualitative Determination of Enzymatic Degradation Products Obtained from Apple Cell Wall Polysaccharides. Mansur Tavakoli and R. C. Wiley. Amer. Soc. Hort. Sci. 87:104-112. 1965.
- A1216 The Use of Objective Tests for Determining Quality of Fresh Green Beans. Morton Fox and Amihud Kramer. Food Tech. 20(12):88-92. December, 1966.
- A1228 Effects of Certain Environmental Factors and Plant Maturity on Bract and Leaf Abscission in *Euphorbia pulcherrima* Willd. Francis J. Marousky and James B. Shanks. Proc. Amer. Soc. Hort. Sci. 88:662-670. 1966.
- A1250 The Effects of Various Levels of Nitrogen, Phosphorus and Potassium on the Growth and Chemical Composition of *Taxus Media* cv Hatfieldi. F. R. Gouin and C. B. Link. Proc. Amer. Soc. Hort. Sci. 89:702-705. 1966.
- A1251 Determination of Hexuronic Acids by Gas Chromatography. R. C. Wiley, Mansur Tavakoli, Marvi Dean Moore. Proc. Amer. Soc. Hort. Sci. 89:34-39. 1966.
- A1261 Penetration and Distribution of Calcium Salts in Thermal Processed Apple Slices as Determined by Autoradiography. J. L. Collins and R. C. Wiley. J. of Food Science 32(2):185-188. Mar.-Apr., 1967.
- A1266 Herbicide Use in Sweet Potato Production. J. D. Long and W. A. Matthews. Penin. Hort. Soc. Trans. 55:7-12. 1965.
- A1267 Effect of Vacuum Time and Steam Blanch Temperature on the Quality of Canned Apple Slices. R. H. Dougherty, Mildred Modery and R. C. Wiley. Proc. Amer. Hort. Sci. 89:46-52. 1966.

Miscellaneous Publications

- #09 A List of Scientific Publications in the Field of Horticulture by the Agricultural Experiment Station, University of Maryland. L. E. Scott. Mimeographed Circular 24 pp. January, 1961.
- #10 Yield and Fruit Size of York Imperial Apple Trees as Influenced by Six Years of Chemical Thinning. B. L. Rogers and A. H. Thompson. Proc. of the 63rd Annual Meeting of Md. Hort. Soc. 3 pp. January 5, 6, 1961.
- #27 Weed Control in Tomatoes and Sweet Potatoes. J. D. Riggleman and W. A. Matthews. Trans. Penin. Hort. Soc. 50:19-22. 1960.
- #37 The Shear-Press, A Basic Tool for the Food Technologist. Amihud Kramer. The Food Scientist 5(1):7-16. 1961.
- #47 The Role of Raw Product Quality in Planning Inventories of Processed Foods. Amihud Kramer. The Canning Trade 86(16):6-9 and 86(17):40-43. February, 1964.
- #62 Sweet Potato Sprout Production. W. A. Matthews and F. C. Stark. Trans. Penin. Hort. Soc. 51:40-42. 1961.
- #69 Definition of Texture and Its Measurement in Vegetable Products. Amihud Kramer. Food Tech. 18:46-49. 1964.
- #70 A Gradient Distributor for the Application of Granular Materials. J. D. Riggleman, G. J. Burkhardt and F. C. Stark. Proc. N. E. Weed Control Conf. 17:73. 1963.
- #71 Quality Control Improves Pack Yields of Sweet Corn. B. A. Twigg. Food Tech. 18(2):62-65. 1964.

- 472 Evaluation of Quality of Fruits and Vegetables. Amihud Kramer. A. A. A. Symposium 77:9-18. 1965.
- 482 Continuous Counting and Sorting of Defects. Amihud Kramer. Food Tech. May, 1963.
- 542 Sensory Evaluation of Food Flavor. Amihud Kramer. Amer. Chem. Soc. 56:64-69. July, 1966.
- 560 Parameters of Quality. Amihud Kramer. Food Tech. 20 (9):53-54. September, 1966.
- 563 Pea Variety Study - 1965. W. L. Hollis. Mimeographed Circular. 6 pp. 1965.
- 564 Snap Bean Variety Study - 1965. W. L. Hollis. Mimeographed Circular. 10 p. 1965.
- 565 Chemical Weed Control in Transplanted and Direct Seeded Tomatoes. J. D. Long and F. C. Stark. N. E. Weed Control Conf. Proc. 20:49-53. 1966.
- 569 Fifty Years of Research in Orchard Fertilization. A. H. Thompson. The Md. Fruit Grower 36(1):11-16. 1966.
- 575 A Review of Chemical Thinning of Peaches. A. H. Thompson. Mountaineer Grower 263:39-40. 1966.
- 576 Water, a Basic Requirement for High Density Plantings of Smaller Apple Trees. A. H. Thompson. Mountaineer Grower 263:13-19. 1966.
- 580 Apple Pectin and Health. R. C. Wiley. Proc. Natl. Apple Utilization Conf. July, 1966. Pp. 58-60.
- 583 Effect of Packaging on Dessication and Other Factors of Quality of Vegetables Held in Frozen Storage. Amihud Kramer. Md. Processor's Report 12(3):9-12. July, 1966.
- 587 Some short- and Long-Term Effects of Herbicides Around Newly-Planted and Mature Peach and Apple Trees. B. L. Rogers. Trans. Penin. Hort. Soc. 55-56-62. 1965.

DEPARTMENT OF POULTRY SCIENCE

Scientific Articles

- A1170 Alkaline Phosphatase in the Reproduction System of the Hen. F. H. Wilcox and W. S. Cloud. Jour. Reprod. & Fert. 10:321-328. 1965.
- A1182 Excessively Inherited Electrophoretic Variant of Alkaline Phosphatase in Chicken Sperm. F. H. Wilcox. Genetics 53(4):799-805. April, 1966.
- A1198 Blood Retained by Chicken Carcasses and Cut Up Parts as Influenced by Slaughter Method. A. W. Kotula and N. V. Helbacka. Poultry Sci. 45:404-410. March, 1966.
- A1200 Hatchability of Eggs Set Small End up. H. M. El-Ibiary, C. S. Shaffner, and E. F. Godfrey. Poultry Sci. 45:419-420. March, 1966.
- A1212 Blood Volume of Live Chickens and Influence of Slaughter Technique on Blood Loss. A. W. Kotula and N. V. Helbacka. Poultry Sci. 45(4):684-688.
- A1222 Correlations Between Growth and Reproductive Traits in the Japanese Quail. H. M. El-Ibiary, E. F. Godfrey, and C. S. Shaffner. Poultry Sci. 45:463-469. May, 1966.
- A1226 Pulmonary Ventilation in a Population of Hatching Chick Embryos. H. M. El-Ibiary, C. S. Shaffner, and E. F. Godfrey. British Poultry Sci. 7(3):165-176. 1966.
- A1229 Growth of *Mycoplasma gallisepticum* Strain J Without Serum. Pauline G. Lund and Mary S. Shorb. Proc. Soc. Expmntl. Biol. & Med. 121:1070-1075. 1966.
- A1230 Incidence of Blood Spots in Coturnix Quail Eggs. E. F. Godfrey and M. H. Taylor. Poultry Sci. 45(1):205-206. January, 1966.
- A1246 Effect of Performance of Selection for High Level of Alkaline Phosphatase in Serum. F. H. Wilcox. Poultry Sci. 45(4):776-784. July, 1966.
- A1259 Evacuated Packaging of Fresh Broiler Chickens. M. H. Taylor, N. V. Helbacka, and A. W. Kotula. Poultry Sci. 45(6):1207-1211. November, 1966.

- A1264 Feather Abnormality in Poults Fed a Diet Deficient in Vitamin E and Selenium. W. C. Supplee. Poultry Sci. 45(4):852-854. July, 1966.
- A1277 Lipoic Acid Requirement of Mycoplasma Species Avian Strain J. Pauline G. Lund and Mary S. Shorb. J. of Bacteriology 94(1):279-280. July, 1967.
- A1281 Lack of Response to Supplementation of a Purified Diet with Menhaden Fish Solubles. W. C. Supplee. Poultry Sci. 45(5):1060-1061. September, 1966.
- Miscellaneous Publications**
- 558 Effect of Protein Level and Quality on Performance of Broiler Chickens Separated by Sexes. G. F. Combs and J. L. Nicholson. Feedstuffs 37(31):42. July 31, 1965.

DEPARTMENT OF VETERINARY SCIENCE

Scientific Articles

- A1168 Tricarballic Acid in the Livers of Sheep. R. B. Johnson. Cornell Vet. LV(4):654-662. 1965.
- A1183 Bovine Lymphosarcoma: The Effect of Inoculation on Newborn Calves and Mice. First Year of Observation. B. C. Hatzios, S. C. Chang, Margaret C. Stevenson and S. B. Mohanty. Vet. Res. 27(117):489-502. March, 1966.
- A1203 Experimental Infection of Calves with Reovirus Type I. P. D. Trainor, S. B. Mohanty and F. M. Hetrick. Amer. Jour. Epidemiology 83(2):217-223. 1966.
- A1211 Experimental Infection of Calves with Hemadsorbing Enteric (Haden) Virus. G. J. Spahn, S. B. Mohanty and F. M. Hetrick. Cornell Vet. LVI(3):377-386. July, 1966.
- A1217 Characteristics of Hemadsorbing Enteric (Haden) Virus. G. J. Spahn, S. B. Mohanty and F. M. Hetrick. Canadian J. of Microbiology 12:653-661. 1966.
- A1223 Experimental Infection of Calves with a Bovine Adenovirus. S. B. Mohanty and Mary G. Lillie. Proc. Soc. Experimental Biol. & Med. 120:679-682. 1965.
- A1239 Cuterebra Larva in the Brain of a Cat. B. C. Hatzios. Jour. Vet. Med. Assoc. 148(7):787-793. April, 1966.
- A1248 Distribution of *Mycoplasma gallisepticum* in Selected Tissues and Organs of Artificially Infected Turkeys. R. L. Peters, J. E. Faber, W. D. Keenum and H. M. DeVolt. Poultry Sci. XLV(5):913-923. September, 1966.
- A1279 Replication of Infectious Laryngotracheitis Virus in Chicken Kidney Cell Culture. V. W. Mayer, F. M. Hetrick, W. D. Keenum and H. M. DeVolt. Amer. Jour. Vet. Res. 28(124):825-832. May, 1967.

CURRENT PROJECTS

(These are projects and not publications available to the public.)

DEPARTMENT OF AGRICULTURAL ECONOMICS

- A-18-au Dairy Adjustments and Supply Response in Maryland and the Northeast. J. W. Wysong.
- A-18-av An Analysis of the Economic Aspects of Beef Cattle Production in Maryland. Sidney Ishee and Graduate Assistant.
- A-18-aw Estimating the Returns to Inputs of Capital and Labor on Maryland Cash Grain and Tobacco Farms. B. V. Lessley.
- A-18-ax Organization of the World's Agricultural Resources. P. W. Foster and Graduate Assistant.
- A-18-ay Profitability of Alternative Feed Handling Systems on Maryland Dairy Farms. J. W. Wysong, J. M. Curtis and Graduate Assistant.
- A-18-ba Optimizing Returns and Resources on the Eastern Shore of Maryland. Sidney Ishee, J. M. Curtis and B. V. Lessley.
- A-18-bb Maryland Farm and Open Country Real Estate Transfers. R. A. Murray, J. M. Curtis and Graduate Assistant.
- A-19-aa The Impact of Economic Investments by Agricultural Product Processing and Marketing Firms Upon the Areas in Which the Investments are Made. F. E. Bender and Rudy DePass.
- A-19-ab United States Private Foreign Investment in Food Processing Plants in Latin America. J. R. Moore.
- A-19-ac Comparative Impact of Current and Alternative Systems of Taxation in Maryland on Farmers and Other Economic Groups and Among Counties. W. P. Walker and J. M. Curtis.
- A-19-ad Demand for and Availability of Land and Water Oriented Recreation Facilities in Maryland. D. F. Tuthill and J. M. Curtis.
- A-19-ae An Analysis of the Effect of U. S. Farm Policies on Maryland's Agriculture. G. M. Beal and J. M. Curtis.
- A-26-bh Trends Pointing to Future Consumption and Market Potential for Meats in the Northeast. R. F. McDonald, J. M. Curtis, F. E. Bender and Graduate Assistant.
- A-26-bm The Export Market for Maryland Agricultural Products. J. R. Moore and Graduate Assistant.
- A-26-bo Analysis of Processing Efficiency and Costs in Broiler Processing Plants. J. C. Maness, J. M. Curtis and F. E. Bender.
- A-26-bp An Analysis of the Current Structure of Livestock and Meat Marketing in Maryland and Surrounding Areas with Estimates Concerning the Future Structure. R. F. McDonald and J. M. Curtis.
- A-26-bq Alternative Marketing Systems for Eggs in the Northeast. R. W. Schermerhorn, J. M. Curtis, F. E. Bender and Graduate Assistant.
- A-26-br Milk Assembly, Processing and Distributing Systems and Practices. G. M. Beal, J. M. Curtis and Graduate Assistant.
- A-26-bs An Economic Analysis of the Role of Farmer Cooperatives as Marketing Organizations. R. J. Beiter and J. M. Curtis.
- A-26-bu Evaluation of Market Structure Performance in Marketing N. E. Fruits and Vegetables. J. L. Cain, J. M. Curtis and Graduate Assistant.
- A-26-bw An Analysis of the Feasibility of New or Reorganized Agricultural Marketing Facilities in Selected Areas of Maryland: A Model Approach. H. D. Smith and J. M. Curtis.

- A-26-bx Impact of Market Structure on Innovations in the Agricultural Industries.
J. R. Moore, J. M. Curtis and Graduate Assistant.

DEPARTMENT OF AGRICULTURAL AND EXTENSION EDUCATION

- T-10 Testing a Procedure for the Improvement of the Reading Ability of Pupils
in Vocational Agriculture Classes. V. R. Cardozier and D. D. Sullivan.
T-12 An Analysis of the Factors Affecting the Status of Private Forest Recreation
Development in Garrett County, Maryland. I. R. Jahns.

DEPARTMENT OF AGRICULTURAL ENGINEERING

- R-11-h Production, Harvesting, Curing and Storing Maryland Tobacco: Mechaniza-
tion of Tobacco Harvest. P. N. Winn, J. H. Hummel, G. J. Burkhardt, E. W.
Martin, N. T. Martin and J. H. Hoyert.
R-16 Pneumatic Handling of Chopped Forage. W. L. Harris, K. E. Felton, G. J.
Burkhardt, N. E. Collins, and J. E. Foster.
R-18 Development of Equipment and Improved Methods for Harvesting Sweet
Potatoes. G. J. Burkhardt and L. E. Scott.
R-21 Development and Construction of Specialized Facilities and Equipment for
Use in Agricultural Research. G. J. Burkhardt and W. C. Schaefer.
R-22 Principles of Mechanical Harvesting of Fruits and Vegetables. (Informal
cooperation with Department of Horticulture). G. J. Burkhardt and L. E.
Scott.
RB-11-g Tobacco Housing. P. N. Winn, R. L. Green, G. J. Burkhardt, E. W. Martin,
N. T. Martin, O. E. Street and J. H. Hoyert.
RM-1 Environmental Requirements of Poultry. P. N. Winn, N. T. Martin, C. S.
Shaffner and E. F. Godfrey.
RHB-23 Application of Energy for Control of Insects. W. L. Harris, W. C. Schaefer,
A. L. Steinhauer, N. A. Clark, and C. C. Blickenstaff.
R-24 Stability of Farm Structures Subjected to Lateral Loads. K. E. Felton and
J. G. Cairns.

DEPARTMENT OF AGRONOMY

- B-43 Soybean Varietal Improvement. E. H. Beyer and B. E. Caldwell.
B-50 Breeding for Better Dent Corn. R. G. Rothgeb and N. A. Clark.
B-56-i Breeding of Improved Varieties of Forage Species Adapted to the Northeast.
E. H. Beyer.
B-56-j Pasture Evaluation Using Beef Steers. A. M. Decker, R. Z. Spry and J. E.
Foster.
B-66 Wheat Breeding and Evaluation. R. G. Rothgeb, J. L. Newcomer, J. H.
Axley, and Graduate Assistants.
B-67 Varietal Improvement in Barley and Oats. R. G. Rothgeb and Graduate
Assistants.
B-73 Morphological and Physiological Responses of Perennial Forage Grasses. A. M.
Decker, R. Z. Spry and N. A. Clark.
B-74 Midland Bermudagrass Hay Production, Feeding Value and Stand Persis-
tence as Affected by Nitrogen Fertilization and Harvest Frequency. A. M.
Decker, N. A. Clark and R. W. Hemken.
B-75 Evaluation of Sod-seeded Forage Species to Supplement and Improve Perma-
nent Pastures. A. M. Decker.
B-76 Red Clover Breeding Investigations. E. H. Beyer.
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A. M. Decker and W. J. Moline.
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- B-79 Use of Herbicides to Control Weeds in Forages. J. A. Meade.
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- B-89 Studies of Some Fundamental Physiochemical Relationships of Tobacco with Respect to Cultural, Fertilization, Curing and Fermentation Practices. O. E. Street, P. N. Winn, Jr. and T. C. Tso.
- B-94 The Effects of Physical Characteristics of Herbicides on Efficiency and Mode of Action When Used on Corn and Soybeans. S. R. Colby.
- B-95 A Study of the Seed Germination, Rhizome Development and Control Methods of Johnson Grass. J. A. Meade.
- B-96 To Investigate the Agronomic Feasibility of Transplanting Tobacco Seedlings in Pressed Peat-Soil Cubes. J. H. Hoyert.
- B-97 Differential Harvesting Management of Red Clover and Red Clover-timothy Stands Under Three Levels of Fertilization. A. M. Decker and L. R. Wade.
- B-98 Physiological and Biochemical Mechanism of Selectivity of Herbicides. S. R. Colby.
- B-99 Factors Related to Irrigation of Tobacco. O. E. Street, J. H. Hoyert, C. G. McKee and B. W. Byrd, Jr.
- B-101 The Effect of Modified Cultural Practices and Environmental Control of Curing Upon the Adaptability to Mechanization and Quality of Maryland Tobacco. J. H. Hoyert and P. N. Winn.
- B-103 Tobacco Breeding, Testing and Quality Evaluations of Maryland Tobacco. B. W. Byrd, Jr., O. D. Morgan, H. A. Skoog and A. C. Hawkins.
- B-104 Tufcote Bermudagrass - Adaptations and Management Requirements for Turf. E. E. Deal.
- B-105 Management of Kentucky 31 Tall Fescue for Park Playground and Athletic Field Turf. E. E. Deal.
- B-106 Factors Affecting Turf Quality and Rate of Maturity of Bluegrass - Red Fescue Sod. E. E. Deal.
- BG-2 Summer Annual Forages for Lactating Dairy Cows. N. A. Clark, R. W. Hemken and J. H. Vandersall.
- BG-3 Cropping Systems for Dairy Farms: A Study of the Growth Responses of Corn and Alfalfa to Soil Fertility and Irrigation: with Concurrent Lactation Studies on the Effects of Corn Silage and Alfalfa Hay and Energy Levels on: Milk Production and Composition and the Physiology of Cows. N. A. Clark, C. B. Kresge, J. H. Vandersall and R. W. Hemken.
- J-95 Development of Improved Strains of Maryland Tobacco Resistant to Disease. B. W. Byrd, Jr., O. D. Morgan, H. A. Skoog and C. G. McKee.
- O-48 Field and Laboratory Soil Characterization Investigations as Related to Soil Genesis, Classification and Utilization. D. S. Fanning.
- O-54 Clay Mineralogy of Maryland Soils. D. S. Fanning.
- O-55 Soil Test Studies. J. H. Axley, W. M. Winant and E. Woolson.
- O-57 More Effective Use of Soil and Fertilizer Nitrogen. J. H. Axley and J. C. Noggle.
- O-62 Micronutrient Requirements of Corn on Important Maryland Soils. J. H. Axley, W. M. Winant and V. A. Bandel.
- O-64 Effect of Nitrogen, Phosphorus and Potassium on the Growth and Development of Forages. C. B. Kresge, A. M. Decker, D. F. Champion and M. G. Schnappinger.
- O-70 Relationship of Soil and Weather to Consumptive Use of Soil Moisture by Selected Field Crops. Edward Strickling, Carroll Stottlemeyer and D. M. Bandel.
- O-71 Nutrient Balance in Orchardgrass as Related to Differential Fertilization. C. B. Kresge and V. A. Bandel.
- O-72 The Effects of Soil Aeration, Mechanical Impedance and Temperature on Root Growth. Edward Strickling, D. M. Bandel, C. S. Britt and G. J. Derco.
- O-73 Nutrient Requirements of Summer Annuals for Forage. C. B. Kresge and I. R. Thomas.

- O-74 Effect of Differential Fertilization on Forage Production and Chemical Composition of Red Clover. C. B. Kresge.
- O-75 The Response of Corn to Fall vs. Spring Plowing, Broadcast vs. Plow-Down Fertilizer and Fall vs. Spring Fertilization. V. A. Bandel.

DEPARTMENT OF ANIMAL SCIENCE

- C-21 The Effect of Specific Metabolites Upon Growth Rate and General Condition of Sheep. E. C. Leffel, J. H. Soares and D. F. Wilson.
- C-25-a The Effects of Roughage Preparation. E. C. Leffel, B. C. Patnayak, R. W. Farmer and D. F. Wilson.
- C-33 A Study of the Effect of Menhaden Fish Meal on the Quality of Protein of Swine Diets and on Total Crude Protein Requirements for Growth of Swine. E. P. Young, J. E. Foster, D. G. Snyder and R. R. Kifer.
- C-34 A Study of the Nutritional and Physiological Influences on Variability of Ovulation Rate and Embryonic Survival in Swine. E. P. Young, J. E. Foster and H. J. Brinkley.
- C-35 Studies on the Efficiency and Composition of Growth in Swine as Affected by Protein and Energy Consumption. E. P. Young, E. C. Leffel and W. R. Bounds.
- C-36 A Study of Factors Affecting the Utilization of Non-protein Nitrogen in High Roughage Diets for Ruminants. E. C. Leffel, N. Satapathy and J. E. Foster.
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- C-40 A Study of the Use of Measurements for the Evaluation of Beef Breeding Cattle. W. W. Green, W. R. Stevens, J. E. Foster and J. L. Carmon.
- C-41 A Study of Variations in Values of Criteria Used in Selection Indices for Beef Cattle. J. Buric, J. E. Foster and W. W. Green.
- C-42 A Study of Rates of Ruminal Digestion and Absorption for the Rumen. E. C. Leffel, R. W. Farmer, D. F. Wilson, M. H. Abbassy and J. E. Foster.

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- F-12 The Native Plants of Maryland, Their Occurrence, Distribution and Economic Importance. R. G. Brown and R. D. Rappleye.
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- F-19 Anatomical, Physiological and Ecological Studies on *Myriophyllum Spicatum* L. R. G. Brown, R. D. Rappleye, Richard Anderson and H. Weirich.
- F-20 An Ecological Study of the Patuxent Estuary. R. G. Brown, R. D. Rappleye, Richard Anderson, Richard Sommer, Charles Philipp and Hugh Gauch.
- J-91 Fungicidal Materials on Cellular Metabolism and Their Usefulness for the Field Control of Vegetable Diseases. H. D. Sisler, J. G. Kantzes, M. R. Siegel, Phillip Vincent and R. A. Paterson.
- J-93 Treatment of Soil and Underground Parts of Plants for the Control of Plant Diseases. O. D. Morgan, J. G. Kantze, L. R. Krusberg, F. J. Williams, W. L. Klarman and E. H. Beyer.
- J-95 Development of Improved Strains of Maryland Tobacco Resistant to Diseases. O. D. Morgan, D. W. Byrd, O. E. Street, J. Hoyert, H. E. Heggsted and H. A. Skoog.

- J-97 Physiology and Biochemistry of Nematode and Nematode-Host Relationships. L. R. Krusberg, M. C. Gardosik, R. K. Howell, R. J. Cole, H. G. Cutler, J. M. Castillo and B. D. Muse.
- J-98 Identification, Characterization and Control of Certain Viruses Affecting Economic Plants in Maryland. H. D. Sisler, O. D. Morgan and John Wells.
- J-99 The Nature and Control of Diseases of Ornamentals and Turf Grasses in Maryland. W. L. Klarman, A. A. Bell and Graduate Assistants.
- J-100 Nature and Control of Major Field and Storage Diseases of Sweet Potatoes in Maryland. J. G. Kantzes.
- J-101 Forest Tree Seedlings and Soil Fungi Relationships. W. L. Klarman and W. K. Hock.
- K-8-c Biophysical and Biochemical Factors in Plant Nutrition. H. G. Gauch, R. W. Krauss, R. A. Galloway and J. E. Bowen.

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- G-34 Chemical Changes in Milk Fat as Related to the Flavor of the Milk. R. L. King, D. Bashore and H. Tikriti.
- G-35 The Analysis of Dairy Products. R. L. King, Neri Clark and R. W. Hemken.
- G-37 Physiology of Metabolic Diseases of Cattle. W. E. Stewart, J. H. Nicolai and R. J. McCormick.
- G-39 Studies on the Mode of Digestion, Absorption and Utilization of Feeds by Ruminants and their Associated Bacteria. R. L. King, E. Heinle, R. W. Hemken, J. Lester, W. E. Stewart, J. H. Nicolai and R. J. McCormick.
- G-42 Methods of Processing and Other Factors Affecting the Quality of Ice Cream. W. S. Arbuckle.
- G-46 The Relationship of the Hypophyseal Growth Hormone and of the Pituitary-Adrenal System to the Productive Capacity of Dairy Cattle for Reproduction and Milk Production. W. F. Williams, G. Lauterbach and Weisshaar.
- G-47 The Nutritive Evaluation of Forages. R. W. Hemken, J. L. Cason, N. A. Clark and A. M. Decker.
- G-48 Flavor Quality of Concentrated Milk Products as a Factor in Milk Utilization and Marketing. Mark Keeney and I. Katz.
- G-50 The Physiology of Progesterone Metabolism. W. F. Williams, G. D. Turner, M. Barends, G. Lauterbach, O. Johnston and B. Fagan.
- G-52 A Study of Factors Affecting the Voluntary Intake, Availability and Utilization of Nutrients in Forages for Growth and Milk Production. R. W. Hemken, J. H. Vandersall, H. K. Goering and N. A. Clark.
- G-53 A Study of the Development, Improvement or Standardization of Manufacturing Processes for the Production of Various Cheeses and the Effect of Specific Factors on the Flavor, Body and Texture of these Cheeses. J. F. Mattick.
- G-54 Analyses of Production and Feed Data from Dairy Records. J. L. Cason.
- GC-45 Studies of the Physiological and Biochemical Nature of Bloat. W. E. Stewart, E. C. Leffel, E. E. Bartley, B. C. Patnayak. D. F. Wilson and R. M. Meyer.

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- H-29-n Chemical Control of Insect Pests of Sweet Corn. F. P. Harrison and L. P. Ditman.
- H-46-e Concentrated Pesticide Sprays. Evaluation of New Insecticides on Vegetable Crops. L. P. Ditman, and G. J. Burkhardt and Graduate Assistants.
- H-48 Chemical Control of Orchard Insects. W. E. Bickley, Castillo Graham and E. R. Krestensen.
- H-64 An Evaluation of the Effectiveness of Commercial Insect Control Practices on Canning Crops. L. P. Ditman.

- H-67 Pesticide Residues in or on Raw Agricultural Commodities. R. E. Menzer, L. P. Ditman, F. P. Harrison and A. L. Steinhauer.
- H-71-d Alfalfa Insects, Their Biology and Control. A. L. Steinhauer.
- H-72 Physiology of Insect Reproduction. J. C. Jones, D. P. Liu and M. F. Sullivan.
- H-73-a The Mosquito Fauna in Selected Swamps, Marshes and Impoundments. W. E. Bickley, R. C. Moore, S. R. Joseph and M. N. Hill.
- H-73-e Laboratory Investigations of Transmission of Several Viral Encephalitides by Certain Maryland Mosquitoes. P. H. Thompson and W. E. Bickley and students.
- H-74 Biology and Control of Tobacco Insects. F. P. Harrison.
- H-76 Comparative Morphology and Physiology of Insect Blood Cells. J. C. Jones, D. P. Liu and Richard Werner.
- H-78 Metabolism of Essential Nutrients and Insecticidal Chemicals in Insects. A. L. Steinhauer and D. McKinstry.
- H-81 Utilization of the Polyhedrosis Virus for Commercial Control of the Cabbage Looper. L. P. Ditman, L. A. Kulp and R. N. Hofmaster.
- H-83 Biology and Control of Loblolly Pine Cone Insects in Maryland. W. E. Bickley, F. E. Wood, R. C. Moore and G. J. Smith.
- H-84 Host Preference of Alfalfa Weevil, *Hypera Postica* (Gyll.) in Relation to Plant Produced Attractants and Repellents. A. L. Steinhauer, R. E. Menzer, H. D. Byrne, C. C. Blickenstaff and S. Brown.
- H-85 Transformation of Insecticides by Plants. Metabolic Transformations of Dimethoate by Plants. R. E. Menzer, G. W. Lucier and Graduate Assistant.
- H-86 The Biology of Biting Midges of the genus *Culicoides* in Maryland. D. H. Messersmith.
- H-87 Control of Bird Depredation. D. H. Messersmith.
- H-88 The Tabanidae of Maryland. P. H. Thompson.
- H-89 Development of Controls for Underground Insect Injury to Sweet Potatoes. L. P. Ditman.
- H-90 Oxidative Dealkylation of Pesticides. R. E. Menzer and G. P. Clemons.

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- Y-2 Properties of Textile-Furnishing Fabrics and Their Importance to Consumer Satisfaction. Eleanor Young, T. F. Mitchell, S. V. Freedman and Marie Bell.
- Y-3 Fertilization Effects on the pH, Titratable Acidity, Chlorophyll and Carotene Content in Broccoli. Mary S. Eheart, Dale Queen and Betty Lugenbill.
- Y-4 Utilization of Amino Acids from Proteins. Pela Braucher, Virginia Dawson and Genevieve Watkins.

DEPARTMENT OF HORTICULTURE

- I-74-a Effect of Environmental Factors and Cultural Practices on the Growth and Flowering of Greenhouse Potted Plants. J. B. Shanks, C. B. Link and William Noble.
- I-74-b Effect of Environmental Factors and Cultural Practices on the Growth and Flowering of Greenhouse Cut Flower Crops. C. B. Link, J. B. Shanks and James Swasey.
- I-79-1 Physiological Differences of Winter and Summer Flowering Varieties of Snapdragons as Related to Growth and Flower Quality. C. B. Link and J. B. Shanks.
- I-79-m Relationship of the Mineral Nutrients and of Nutrient Level to the Growth and Development of Certain Woody Ornamental Plants Growing in Containers. C. B. Link and F. R. Gouin.

- L-74 Environmental Factors and Cultural Practices in Relation to the Growth and Fruiting Responses of Fruits. A. H. Thompson and B. L. Rogers.
- L-74-b Chemical Thinning of Peaches. A. H. Thompson and B. L. Rogers.
- L-74-c Size Control of Fruit Trees with Chemicals. A. H. Thompson and B. L. Rogers.
- L-79-e Mineral Nutrition of the Apple with Reference to the Development of Cork Spot and to Respiration, Enzyme Activity and Storage Life. A. H. Thompson, B. L. Rogers and H. G. Gauch.
- L-79-f Post Harvest Physiology of Pomological Fruits. L. E. Scott, J. C. Raulston, M. D. Moore and S. H. Todd.
- L-79-g Chemical and Non-Chemical Measures for Protection of Perishable Food Commodities in Marketing Channels. L. E. Scott, G. J. Stadelbacher and B. D. Horton.
- L-100 Vegetative Propagation of Pine by Needle Fascicles. R. L. Baker and I. C. Haut.
- Q-58-a Rapid Nutritive Evaluation of Processed Vegetables. A. Kramer.
- Q-58-k Development of Specifications for Canned Food Quality. A. Kramer.
- Q-58-m Development of New Products and Improved Processing Methods. A. Kramer, B. A. Twigg, R. C. Wiley and Mildred Modery.
- Q-58-n Suitability of New Varieties of Horticultural Crops for Canning and Freezing. W. L. Hollis, F. F. Angell and L. E. Scott.
- Q-58-p Quality Improvement of Canned Apple Slices and Sauce Through Studies of the Relation of Water Insoluble Constituents of the Fresh Fruit to the Textural Quality of the Processed Product. R. C. Wiley, A. H. Thompson, M. Tavakoli, R. G. Dougherty, J. L. Collins, T. Chase and Mildred Modery.
- Q-58-r Quality Maintenance, Measurement and Control in the Marketing of Vegetables Including Potatoes. A. Kramer, R. C. Wiley, B. A. Twigg, W. L. Hollis, M. Modery, S. J. Palmer, S. Angel and J. Rasekh.
- Q-58-s Quality Maintenance, Measurement and Control in the Marketing of Vegetables Including Potatoes. A. Kramer, B. A. Twigg, S. J. Palmer, S. H. Todd and L. Hodgson.
- Q-74 A Study of Regional Adaptation of Certain Vegetable Crops and Varieties in Maryland. W. L. Hollis, B. A. Twigg, F. C. Stark, F. F. Angell, L. E. Scott and C. W. Reynolds.
- Q-77 Crop Management Studies with Vegetable Crops. W. L. Hollis, F. C. Stark and C. W. Reynolds.
- Q-77-b Efficacy and Selectivity of Chemical Herbicides for Controlling Major Weed Species in Truck Crop Production. J. D. Long, W. A. Matthews, G. J. Stadelbacher and F. C. Stark.
- Q-81 Cantaloupe Breeding and Selection with Particular Reference to Quality and Resistance to Defoliation. F. F. Angell and F. C. Stark.
- Q-81-b Sweet Potato Breeding and Selection with Particular Reference to Quality and Resistance to Cracking. F. C. Stark, L. E. Scott, W. A. Matthews and F. F. Angell.
- Q-81-c Genetics and Breeding of Sweet Corn. R. J. Snyder and Perry Nugent.
- Q-81-d Tomato Breeding and Selection with Particular Reference to Adaptation to Mechanical Harvest and to Processing. F. F. Angell, F. C. Stark and D. A. White.
- Q-83 Soil and Plant Factors Affecting Water Utilization by Selected Vegetable Crops. C. W. Reynolds, F. C. Stark and R. J. Adkins.
- Q-83-b Root Distribution and Root Density of Selected Vegetable Crops as Related to the Absorption of Soil Water and the Uptake of P^{32} . C. W. Reynolds and R. J. Adkins.
- Q-84-a Effect of Traces of Oxygen and Other Gases on the Preservation and Flavor Development of Plant Materials. A. Kramer and S. J. Palmer.

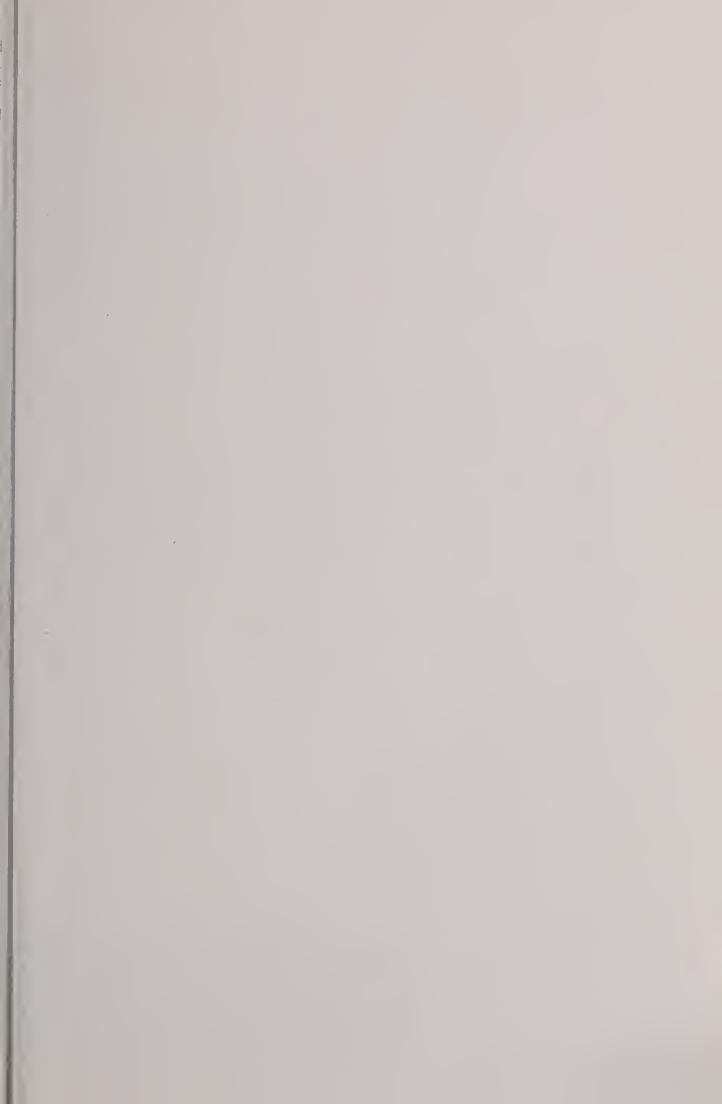
DEPARTMENT OF POULTRY SCIENCE

- M-32-m Genetic Differences in Alkaline Phosphatase Concentration of Blood Sera as Related to Differences in Egg Production and Egg Quality. F. H. Wilcox, C. S. Shaffner, W. S. Cloud, H. V. Auger, H. R. Wilson, P. M. Macomber, P. C. Harris, R. E. Seagrave, D. P. Smith and C. V. Rodriguez.
- M-58 Metabolic and Nutritional Studies on Microorganisms Important to the Poultry Industry. M. S. Shorb, P. G. Lund, Winifred Knuese and Barry Lutsky.
- M-59 Lipid Metabolism of Fowl Spermatozoa. M. S. Shorb and Brian Dunlap.
- M-61 A Study of Causes of Bruising in Transportation of Live Broilers from Farm to Processing Plant and Possible Methods for their Reduction. N. V. Helbacka and M. H. Taylor.
- M-62 The Effect of Folic Acid Supplementation of a Practical Type Turkey Breeder Ration of Hatchability of Eggs and Quality of Offspring. W. C. Supplee and C. S. Shaffner.
- M-63 A Study of the Relationship of Vitamin E to the Enlarged Hock Disorder in Turkey Poult. W. C. Supplee.
- M-64 Effects of Gonadal Hormones on Embryonic and Postnatal Bone Growth in Chickens. E. F. Godfrey and C. S. Shaffner.
- M-66 Applied Broiler Nutrition Studies. G. F. Combs, P. F. Twining and E. H. Bossard.
- M-67 The Effect of Processing on the Availability of Energy and Amino Acids in Wheat and its By-Products. R. D. Creek.
- M-100 Quality Retention in Poultry Meats as Influenced by Methods of Processing. N. V. Helbacka, A. W. Kotula, and M. H. Taylor.
- M-206 A Study of the Calcium Requirement of Young Turkeys. W. C. Supplee and C. S. Shaffner.
- M-207 Study of Chick RBC Transketolase as an Index of Thiamine Nutriture. G. F. Combs and P. Padhi.
- M-208 Use of Chick Bio-Assay in Measuring Specific Amino Acid Availability. G. F. Combs, E. Bossard, V. Vasaitis and D. L. Blamberg.
- M-209 Effect of Protein Level and Amino Acid Balance on Voluntary Food Consumption. C. S. Shaffner, G. F. Combs, D. L. Blamberg, V. Vasaitis and A. K. Khalil.
- M-210 Determination of Amino Acid Requirements of Growing Broiler Chicks and Laying Hens. G. F. Combs, O. P. Thomas, V. Vasaitis, E. Bossard and P. Twining.
- M-303 The Performance of Populations of the Domestic Fowl as Influenced by Heritable Physiological Traits and by Genes with Known Pleiotropic Effects. F. H. Wilcox, C. S. Shaffner and H. A. Engh.
- M-400 Effect of Protein Adequacy on the Efficiency of Selection for Early Fattening of Turkeys. C. S. Shaffner, G. F. Combs and E. F. Godfrey.

DEPARTMENT OF VETERINARY SCIENCE

- D-52 Respiratory Disease of Poultry. F. K. Willis and I. M. Moulthrop.
- D-57 Epizootiology of Equine Encephalitis in Maryland. M. J. Collins, Jr., H. M. DeVolt, F. S. Yancey, L. L. Hood and James Sharp.
- D-58 An Investigation to Study the Use of the Tetrazolium Salts in a Rapid Screen Test and Rapid Sensitivity Test in Mastitic Milk. E. J. Schultz and Barbara Reisner.

- D-59 The Investigation of Fluorescent Antibody Technique with Respiratory and Other Diseases of Poultry. H. M. DeVolt, R. L. Peters and Willene Keenum.
- D-62 Infectious Diseases Affecting Reproduction in Cattle with Special Reference to Vibriosis and Leptospirosis. F. S. Yancey and W. R. Anderson.
- D-63 Study of Bovine Respiratory Diseases. S. B. Mohanty, M. G. Lillie and G. P. Spahn.
- D-64 An Investigation to Study the Propagation of Avian Viruses in Tissue Culture. H. M. DeVolt, V. W. Mayer and Willene Keenum.
- D-65 Studies on Etiology and Pathogenesis, Laboratory Diagnosis and Chemotherapy of Bovine Lymphosarcoma. B. C. Hatzios.
- D-66 A Study of the Toxic Substances Produced by *Stachybotrys Atrata*. R. B. Johnson and H. M. DeVolt.





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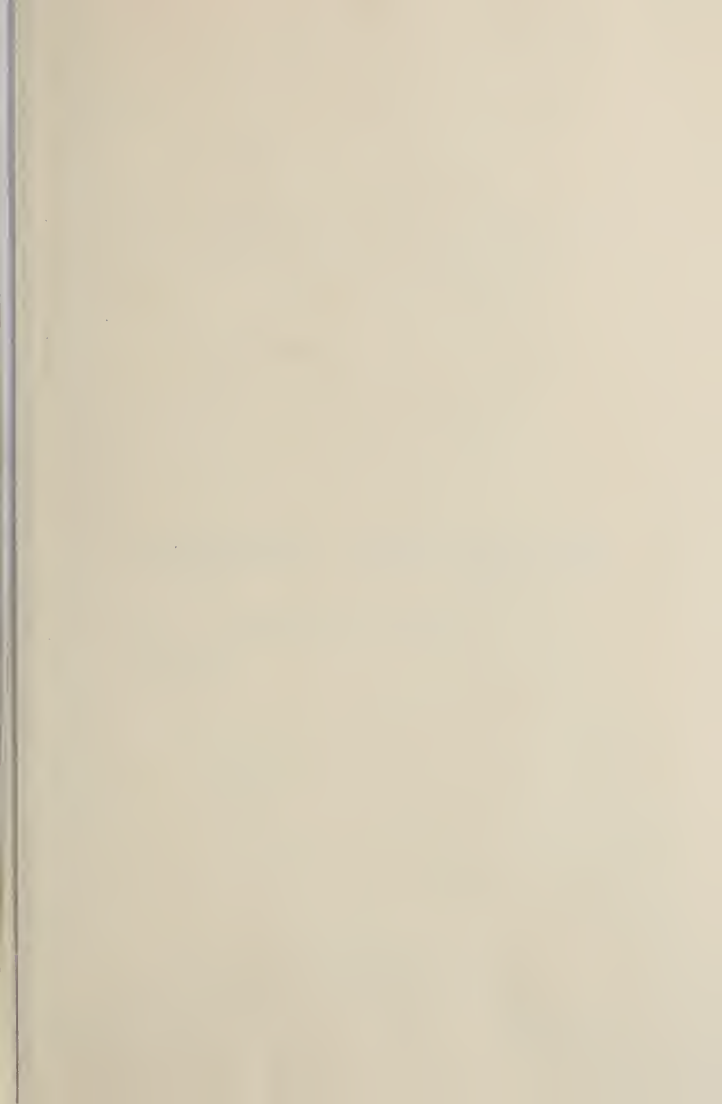
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